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COLONY AND PROTECTORATE OF KENYA.

Department of Agriculture Annual Report 1928

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ANNUAL REPORT, 1928.

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ANNUAL REPORT OF THE DIRECTOR OF AGRICULTURE.

FOR THE YEAR ENDED 31st DECEMBER, 1928.

REPORT OF DIRECTOR.

Staff, etc.

No new services, distinctive in character from existing activities, were undertaken during the year under review, with the exception of a locust campaign, but, as revealed in the sectional reports of senior officers, there has been a marked increase in Departmental services of value to the agricultural industry. That has been achieved, not only through additional appointments, but is the result of experience acquired by the staff and preliminary work done in previous years. The staff was strengthened during the period under review by the addition of five Veterinary Officers, one Live Stock Officer, three Assistant Agricultural Officers, one Assistant Entomologist, and one Assistant Grader and Inspector, to the technical divisions.

Apart from the disorganisation which is inevitably the outcome of absences on leave, great difficulty continues to be experienced in the extension of services and in maintaining continuity and efficiency through the delay which occurs in filling vacant posts. The paucity of suitable candidates has been fully dealt with in the Report of the Committee on the " Colonial Agricultural Service ".

The establishment of a technical department on a complete basis necessarily occupies a great deal of time. Only young and inexperienced men can as a rule be recruited for new posts, and some time must elapse before they have acquired experience and a knowledge of local conditions.

It can be said with assurance that substantial progress is being made in steadily improving the organisation of this department, and that the officers recruited during recent years are already rendering useful service and will become still more efficient and valuable in the near future.

The demands of a section of the community served are insistent and heavy, and are greatly increased not only by the want of experience of farmers themselves but by the great diversity of crops grown, the conditions under which the live stock industry is pursued, and the fact that the agricultural industry can only be regarded as in the initial stages of its development.

Problems connected with crop and live stock economics, soil fertility, diseases and pests, can only be dealt with satisfactorily after prolonged research and experiment, and solved with the aid of the accumulated experience gained by farmers themselves.

The importance of the equipment of a Department of Agriculture in respect of staff and material and the necessity to work in advance of the need, as stated in previous reports, need not again be emphasised. During the latter half of the year the normal work of the Department suffered on account of the disorganisation which took place in order to cope with the locust invasion. The campaign for locust destruction had to be organised hurriedly by the detachment from their ordinary duties of members of the staff immediately available. At one period there were so employed, five Agricultural Officers, one Entomologist, as well as the Senior Agricultural Officer, and the Deputy Director of Agriculture, who was charged with the control and direction of the campaign. An opportunity was thus given for a number of the younger officers of the Department to gain experience in locust destruction, an experience which should prove to be of great value in later years if the Colony should again be invaded by this serious plague.

The provision made for the employment of Agricultural Officers will relieve the research workers of some itinerant and advisory services and will enable them to devote more time to research.

It is becoming increasingly difficult for the rapidly growing volume of technical administrative work at headquarters to receive that adequate thought and attention which it demands. In a young Colony, with its agricultural industry continually expanding and undergoing change, it is important that its Department of Agriculture should be elastic in organisation and be able to undertake new services without frequent changes of methods of control and administration. At this stage, the scope of many of the activities and functions of this Department is not such as to justify their grouping under a number of responsible heads. The time has, however, arrived when additional assistance is needed at headquarters for the discharge of technical administrative work of a responsible character.

The principal staff changes are indicated in Appendix "A".

Financial.

Statements of Expenditure and Revenue for the Fiscal Year under review are given hereunder :—

Expenditure	Amount Originally Sanctioned	Amount Expended
	£	£
Administrative and General (including Total Cost of Headquarters Staff)	21,321	19,038
Native Agriculture	12,604	11,547
Scott Agricultural Laboratories	8,074	8,369
Plant Breeding Services	3,348	3,379
Grading, Conditioning Export Produce	5,726	5,460
Grant to Kenya Agricultural Society	500	500
Contributions to Imperial Bureaux of Entomology and Mycology	450	450
Contribution to Amani Institute	1,200	1,700
Contribution to Imperial Scheme for Agricultural Scholarships	623	623
Expenses in connection with Locust Destruction..	..	20,892
Veterinary—		
(*a*) Executive Division	58,119	48,852
(*b*) Research Division	33,803	30,332
Total Agricultural Department £	145,768	151,142

The savings shown are chiefly due to delay in making new appointments, and in the case of the Veterinary Research Division to a small output of anti-rinderpest serum.

Revenue	Original Estimates	Actual Receipts
	£	£
Agricultural Produce, Grading, Conditioning and Cold Storage Fees, etc.	6,500	4,905
Farm Produce and Stock	100	290
Sundry Stores	100	991
Veterinary Inoculation Fees, etc...	37,000	16,877
Sera, Vaccines and Laboratory Products ..	4,000	10,830
Total Agricultural Department £	47,700	33,793

The reduction in the first item is due to the smaller export of maize; " sundry stores " include revenue derived from the sale of " ant repellent " amounting to £553, not included in the estimate. The position in regard to revenue from veterinary inoculation fees is stated in the report of the Chief Veterinary

Officer, the shortfall being chiefly accounted for by the conditions of drought which prevailed in the Native Reserves, also to inadequacy of staff for carrying out these services on the scale estimated.

An analysis of Expenditure and Revenue is given under the following heads :—

1. Agriculture (other than Veterinary)—
   (*a*) Headquarters Administration, Staff, etc.
   (*b*) Research.
2. Veterinary—
   (*a*) Executive Division.
   (*b*) Other Services.

This statement is exclusive of the expenditure of £20,892 on locust destruction, which was exceptional, and which was not included in the ordinary Departmental Estimates.

	1926	1927	1928
	£	£	£
1. Agriculture (other than Veterinary)			
(*a*) Headquarters Administration Staff, etc.	15,140	15,094	17,038
(*b*) Other Services—			
Native Agriculture.. ..	9,209	9,702	11,547
Scott Agricultural Laboratories	8,344	7,763	8,369
Plant Breeding Services ..	..	2,665	3,379
Grading, Conditioning and Cool Stores	3,965	5,929	5,460
Grants to outside bodies, etc.	1,235	2,750	3,273
Gross Expenditure ..	37,893	43,903	49,066
Revenue	5,349	6,953	6,086
NET EXPENDITURE ON AGRICULTURE (other than Veterinary) .. .. .. £	32,544	36,950	42,980
2. Veterinary*—			
(*a*) Executive Division	40,427	43,690	50,652
(*b*) Research	29,886	30,088	30,532
Gross Expenditure ..	70,313	73,778	81,184
Revenue	30,032	27,574	27,707
NET EXPENDITURE ON VETERINARY SERVICES .. £	40,281	46,204	53,477
TOTAL NET EXPENDITURE AGRICULTURAL DEPARTMENT £	72,825	83,154	96,457

* These figures include the share of cost of Headquarters Office Services, *e.g.*, Clerical, Accounts, Storekeeping, etc., rendered for "Veterinary." Accordingly £1,800 has been debited to Veterinary (Executive Division) and £200 to Veterinary Research.

It may be noted that the proportion of the net appropriation spent upon the protection of the live stock industry is high when compared with that spent upon *all* other services.

GENERAL.

The rainfall during the year 1928 was generally under average, and as a consequence crops suffered in some districts. The yield of coffee was much reduced. The estimate of yield for the season was 7,800 tons at the end of December, as compared with an actual production of 12,300 tons in the preceding year. Excepting in the Nyanza Province, where yields were high, the maize crop was below average, and in parts of the Nakuru District it largely failed on account of drought. The wheat crop also suffered in like manner, and in the higher districts which enjoyed a sufficient rainfall the yield was greatly reduced by " rust." In several districts a number of farmers suffered some loss in the destruction of maize and wheat crops by locusts. From the same cause some damage, though not extensive, was caused to native food crops.

Owing to shortage of rain generally a smaller surplus of crops was available for sale from the Native Reserves, and in some areas a shortage of food existed. Grazing in the pastoral areas was poor, and resulted in low condition of stock generally and a reduced output of produce and animals fit for market.

Notwithstanding the adverse seasons, development on the whole continues at a satisfactory rate. Success in farming is dependent upon many factors, including skill and experience, and while there is evidence of substantial progress in many directions, it is becoming more and more apparent that there is a lack of good management upon too large a proportion of holdings. A considerable number of farmers possessed no previous experience when they settled in this Colony, and it stands to the credit of many of them that they have learnt the " art of agriculture " and have achieved success, but there are many others who apparently do not possess a " bent " for farming. They are not likely to succeed in any circumstances, and it is feared that they will always lag. Too often the management of the farm is left in the hands of young and inexperienced persons and the work to irresponsible native labourers without skilled and continuous supervision. True it is that there is a number of highly intelligent landowners and farmers who are capable of appreciating the value of science and sound practice as applied to agriculture, and they are beginning more fully to recognise that success can only be achieved by a close study of the problems which affect the industry. In particular there has been a general awakening to the importance of maintaining soil fertility. The place which " mixed farming " should occupy in the system of agriculture pursued has been referred to in previous Reports,

but progress in this direction is slow. In so far as it implies growing a wider range of crops, it is now being realised that a rotation is very necessary for several reasons, but the farmer who is struggling to become established is not disposed in the earlier stages to grow crops the produce of which is not marketable at a profit, however valuable these crops may be as " restorers " and " improvers " of soil fertility.

Again, in so far as " mixed farming " means the inclusion of stock in the operations, the impediments are the incidence of disease in the mostly highly productive areas, and the low productive capacity of the cattle, whether for beef or milk production. To feed crops and artificial foods profitably presupposes a supply of good dairy cows which will respond to such a system of management. Unfortunately, the local supply of such cows is at present so small that the system cannot be applied extensively within a short time.

Mechanical cultivation has been encouraged by the rebate given by Government to users of kerosene for agricultural purposes. The great advantages derived from this efficient and expeditious form of performing agricultural operations is unfortunately to some extent discounted by its present comparatively high cost. In the light of experience, there is a tendency more fully to combine the use of tractors and draught oxen in the major farming operations. This combination is likely to prove not only efficient but the most economical.

In experimental work much of great value to the industry, both in regard to European and native interests, remains to be done. Up to the limit of its resources every effort has been made by the Department to secure reliable data and information, but in the absence of a number of experiment stations spread throughout the Colony work of this kind cannot be carried out to the greatest advantage. Co-operative experiments with farmers who have undertaken to carry out all the work have in a large measure failed, as they have done in other countries where such have been attempted. That is not surprising, for the farmer and his labour are busily engaged on the sowing and harvesting of the main crops of the farm just at those periods when the experimental plots demand much and close attention. Cultural conditions, largely governed not only by soil variation but by the rapidly changing conditions due to climate and altitude, vary greatly within comparatively short distances, and it is seen that a large number of experiment stations would be required to cover the needs of the Colony completely, but at the present stage sanction could hardly be expected for their cost. The present development is therefore to build on to the work of a specific kind which is being done at the Scott Agricultural Laboratories and the Plant Breeding Station at Njoro, by obtaining the use of land on

private farms, together with assistance in the form of cultivations and labour, for carrying out a range of experiments designed by the Department and under the control and supervision of an Agricultural Officer stationed in the area, with the assistance of a limited number of trained Africans to carry out the skilled work of planting, harvesting, weighing, etc. From co-operative work so carried out, much useful information should be obtained at a comparatively small cost, though it will not be so complete nor so satisfactory as if it resulted from work carried out at a properly staffed and equipped experiment station.

In that extensive area of highly productive land forming the Trans Nzoia district, where there is considerable uniformity in agricultural conditions and practice, an experiment station would prove to be of particular value. For the extension of plant breeding services, *e.g.*, in maize selection and in investigating the diseases of "rust" and "white blight" in this important crop, and in an endeavour to overcome them by the raising of disease-resistant types, a station so located would be capable of rendering much valuable service.

Meteorological.

During the year arrangements were made for the organisation of an East African Meteorological Service under the direction of the Government Statistician. This Department has accordingly arranged to hand over all existing stations to the new service.

During 1928 the number of stations whose records are tabulated in the Meteorological Report, which is published annually, was 188. These are comprised as follows :—

	No. of stations.
(*a*) Agricultural, Forestal and Public Works	18
(*b*) District and Military	32
(*c*) Railway	17
(*d*) Private	121
	188

A summary of the meteorological records for 1928 is appended hereto (Appendix R.)

Agricultural Statistics.

The ninth Agricultural Census for the year August 1st, 1927, to July 31st, 1928, was compiled and published. The following tables and appendices were submitted with the report :—

(1) Acreage under occupation, under cultivation, and under the principal crops.

(2) Numbers of live stock, the property of Europeans.
(3) Classification of cattle, the property of Europeans.
(4) Deaths of cattle, horses, mules, donkeys, sheep, goats, pigs and poultry, the property of Europeans.
(5) Stock, the property of Europeans, slaughtered for consumption on farm.
(6) Animal products sold by European occupiers.
(7) Cereals, total production; acreage harvested, and yield per acre of cereals (maize, wheat and barley).
(8) Coffee, acreage planted, age of trees, and yield of clean coffee and buni.
(9) Tea, area planted, estimated area to be planted in succeeding year, and production of tea.
(10) Sisal fibre, acreage planted, age of plants and yield of fibre.
(11) Coconuts, acreage planted, numbers and age of palms, and production of nuts and copra.
(12) Wattle, acreage, age, and production of dry bark.
(13) Number of fruit trees (the property of Europeans) planted.
(14) Agricultural implements and machinery in the possession of Europeans.
(15) Number of native squatters resident on European holdings, acreage occupied and cultivated by squatters, and numbers of squatters' live stock on European holdings.
(16) Average number of units of labour employed on agricultural holdings.
(17) Average number of units of labour (men, women and children) employed on agricultural holdings.
(18) Average monthly wages paid to labourers and average monthly value of labourers' rations.

Crop Reports.

A system of forecasting crops was introduced during the year, and reports were published in respect of the months September to December.

The thanks of the Department are due to the 178 crop correspondents who submitted monthly estimates of their crops and by so doing enabled the Department to inaugurate successfully this valuable service.

Imports.

The following schedule gives particulars of the imports into Kenya and Uganda of certain products. This statement is of importance in its relation to the development of the agricultural industry, the markets, and their extent, which remain unfilled with local produce.

IMPORTS—KENYA AND UGANDA.

		1928	1927	1926	1925	1924	1923	1922	1921	1920	1914
QUANTITY											
Wheat	*wt.*	3,754	2,904	2,821	2,635	1,993	1,983	900	1,352	337	5,585
Wheat Meal and Flour	,,	64,742	63,843	58,257	53,657	48,474	47,699	59,817	78,069	76,823	81,898
Ham and Bacon	,,	93	124	121	58	23	5	9	20	118	701
Butter	*lb.*	16,464	6,832	2,576	2,688	1,120	560	4,032	11,081	3,890	34,997
Cheese	,,	29,344	18,032	13,216	3,854	3,248	1,456	1,792	2,561	12,636	38,836
Ghee	*cwt.*	8,986	10,475	7,099	7,309	8,592	5,233	4,209	1,878	600	2,347
Condensed Milk	,,	12,170	8,531	8,009	6,258	5,352	3,105	1,305	4,560	5,210	9,468
Sugar	,,	80,244	9,623	19,567	27,161	27,446	31,632	69,212	65,958	47,921	74,485
VALUE											
Wheat	£	3,227	2,694	2,612	2,524	1,623	1,590	879	1,900	515	3,001
Wheat Meal and Flour		57,231	58,739	57,929	56,364	40,790	40,362	63,775	102,025	112,795	52,890
Ham and Bacon		848	1,253	1,304	641	217	73	117	285	1,368	4,256
Butter		1,624	675	275	283	122	74	412	1,383	515	1,972
Cheese		2,968	1,780	1,397	401	292	180	201	354	922	1,820
Ghee		36,372	46,832	49,838	42,685	28,740	13,717	14,631	13,900	3,510	8,702
Condensed Milk		39,115	27,321	29,132	22,990	20,851	11,912	5,247	25,076	22,554	20,498
Sugar		68,903	10,661	20,265	31,475	42,049	54,041	89,405	129,869	167,554	54,829
TOTAL	£	210,288	149,910	162,752	157,363	134,686	121,949	174,667	274,792	309,733	147,968

The import of wheat is of a kind said to be required by the Indian population for their own particular needs. The wheat flour imported is used chiefly at the Coast where it has not yet been completely displaced by the local product, but it should be added that the local millers adjusted their prices of flour towards the latter end of the year in a manner calculated to capture this market. The increase in the imports of butter and cheese, though they remain comparatively small, are due to the shortage occasioned by drought in the pastoral areas in the early part of the year. The import of ghee is chiefly from Tanganyika and partly Buffalo ghee from India. The increase in the import of sugar is considerable and is partly due again to conditions of drought as explained further in later pages of this Report.

These figures taken with those showing the increase in production of the same products indicate the extent to which local consumption is increasing, due not only to growth in population, but to the increased purchasing power of the native peoples.

Exports.

(*Vide Appendix "S."*)

The total value of agricultural exports, the produce of Kenya, in 1928 was £2,747,233; an increase of £15,439 as compared with the previous year.

The tonnage was 104,519 tons in 1928 against 138,412 tons in 1927. This decrease is mainly due to the reduction in the quantity of maize shipped during the year.

Given even normal seasons and no serious fall in market prices the quantities and values of agricultural exports should again show a substantial increase.

The statistical information given in succeeding sub-sections of this Report relate, except where otherwise stated, to agricultural development by Europeans. More complete information is to be found in the Annual Agricultural Census Report.

Acreage and Occupation.

The total area allotted for occupation by Europeans is approximately 6,720,646 acres, and in addition an area of about 894,720 acres are still available for alienation. Of the area allotted, 4,996,406 acres are under occupation showing the satisfactory increase of 258,486 acres over the previous year. The number of European occupiers totals 1,971, a net increase of 70 over the previous year, but it is calculated that changes of occupiers took place in 78 holdings making the number of new occupiers, 148.

The number of Europeans employed on agricultural holdings inclusive of the 1,971 occupiers, is returned at 2,807, an increase of 185 as compared with the previous year.

The total area under cultivation is 592,741 acres, giving an average of 301 acres per occupier, as compared with 269 and 256 acres for the years 1927 and 1926 respectively.

Including land used for stock farming, it is estimated that the area beneficially occupied is on the average 1,266 acres, which shows the extensive character of farming operations in this Colony. In addition, mention should be made of the considerable area of farms used by "native squatters."

In the returns furnished it was shown that on European holdings they had 47,111 acres under cultivation, and 878,502 acres were used for the maintenance of their stock.

Main Crops.

On 31st July, 1928, the total area under crops was 525,421 acres, and the total area under cultivation was 592,741 acres. For comparative purposes figures for the previous year are given, together with the percentages of increase and decrease, in the appended table :—

	1928	1927	Increase	Decrease
			%	%
Maize	215,960	192,592	12·13	—
Wheat	88,429	65,036	35·96	—
Barley	5,933	4,093	44·95	—
Coffee	84,073	74,662	12·60	—
Sisal	91,909	71,213	29·06	—
Tea	4,809	3,156	52·37	—
Coconuts	7,994	8,113	..	1·46
Sugar Cane	9,408	6,811	38·12	—
Miscellaneous	24,384	17,194	41·81	—
Total Acreage of Crops Grown	532,899	442,770	20·35	—
Less Catch Crops	7,478	4,735	57·93	—
Net Area under Crops ..	525,421	438,035	19·94	

Maize.

The figures quoted above show an increase of 23,368 acres in the total area of 215,960 acres planted as at July 31st, 1928. The average yield over the Colony was 6.15 bags per acre showing a reduction due to unfavourable weather conditions.

The following table showing the acreages and yields of maize in past years is of interest :—

Year	Acreage Harvested	Actual Production	Bags per Acre
	Acres	*Bags*	
1923–1924	108,556	833,640	7·68
1924–1925	129,647	893,108	6·89
1925–1926	155,751	826,614	5·95
1926–1927	177,987	1,314,643	7·39
1927–1928	177,009	1,088,706	6·15

Exports of maize (including native grown) for the season (August-July) fell from 1,100,708 bags in 1926-27 to 805,801 bags in 1927-28.

Crop estimates for the 1928 planted crop show a production of about 1,100,000 bags of which it was estimated that 800,000 bags would normally be available for export. Good crops from this planting were raised in most areas excepting part of the Nakuru District, but as maize is the main crop grown over an extensive area in that district, the shortfall in total output is very considerable, and the effect was to reduce considerably the average yield for the Colony.

Selection work is being carried out both at the Plant Breeding Station at Njoro and at the Scott Agricultural Laboratories, and an investigation has been started on resistance to " White Blight " (*Helminthosporium turcicum Pass.*) from which some crops, chiefly in the Trans Nzoia, suffered considerably during this season.

The maintenance of soil fertility, on maize farms in particular, is also engaging attention. Experimental work thereon is being conducted at the institutions named above, also in co-operation with farmers. In the light of information at present available, farmers have been advised as to the farming practice which should be adopted to maintain and improve the soil fertility.

The " grading " service continues to work smoothly and no complaints have been made by the trade, either oversea or locally. During one period only congestion existed at the Maize Conditioning Plant. Experience shows that in certain districts it is difficult for the grower to get the grain sufficiently dry for export. The writer took an opportunity of investigating this matter in collaboration with the Agricultural Engineering

Institute at Oxford, and enquiries are being pursued as to the feasibility of introducing means of artificially drying maize on farms.

Another representative and successful Maize Conference was held in August, and some of its deliberations took place in joint session with the Wheat Conference.

Wheat.

The area planted as at 31st July, 1928, was 88,429 acres, an increase of 23,393 acres over the previous year.

The acreage harvested in each year and the production during the past five years are as follows :—

Year	Acreage Harvested	Actual Production
	Acres	*Bags*
1923–1924	19,599	55,920
1924–1925	23,996	61,067
1925–1926	30,627	80,069
1926–1927	46,601	120,569
1927–1928	75,102	173,958

The satisfactory prices which ruled during the previous years for wheat, the improvement and increased capacity of grain mills, the security against " rust " at the lower altitudes afforded by the variety " Kenya Governor " evolved by this Department, and the increase in cultivation of farms at elevations of 8,000 to 9,000 feet, together stimulated a great increase in production. The industry has now reached the stage when sufficient wheat is produced to meet the requirements in flour of this Colony and adjacent territories. But that position is not yet completely secure. Unfortunately " Black Stem Rust " (*P. graminis*) for the first time seriously affected the yield of the 1928 crop in the variety " Equator," the standard crop of the higher alttiudes, where it had hitherto been supposed that this form of rust was not a menace.

While average yields on good land in the best districts reach 30 bushels or more per acre, the average for the Colony remains phenomenally low, at about 8 bushels per acre. That is to be accounted for by sowings made on the poorer soils, drought in some areas, heavy losses due to rust, and destruction by birds.

Experience only will teacher the farmer that it is a mistake to suppose that wheat can be grown profitably on poor soils which are not considered good enough for other crops.

The improvement of their fertility by the application of manures is receiving some attention, but that may not in all cases be an economic proposition, if other disabilities such as shortage of rainfall occurs frequently at critical periods in the growth of the crop. Reference is made elsewhere in this Report to the valuable work being done on the production of rust-resistant varieties. The bird pest is becoming serious in certain districts and presents a difficult problem inasmuch as, on present information, the species of birds causing the damage appear to eat soft vegetation chiefly and are not ordinarily eaters of hard grain. They cannot therefore be destroyed by poisoned grain. An enquiry has been commenced in an attempt to identify the different species. That should be followed by a study of their habits, but it is to be regretted that no officer with sufficient knowledge to conduct an investigation, which will necessarily be of a protracted character, is available for the purpose.

The progress made in wheat breeding will be dealt with in the section covering Plant Breeding Services, and certain important research work on "rusts" is referred to in the Mycologist's Report.

At the Wheat Conference already mentioned, it was agreed that a system of compulsory official grading should be instituted for "export" wheat. Rules and standard grades were promulgated under the Agricultural Produce Export Ordinance, 1921. Towards the end of the year, 136,640 cwts. of wheat valued at £76,195 were exported chiefly to Indian and South African markets. In addition, 17,717 cwts. of flour valued at £17,549 were exported chiefly to Tanganyika and Uganda. It can be said with confidence that wheats of good milling quality can be grown for export to oversea markets.

Through the enterprise of the Kenya Farmers' Association a large addition has been made to the storage capacity for wheat to be stocked at their mill. Thus a difficulty experienced in storing wheat on farms, where inadequate facilities exist, has been removed to a large extent.

Wheat milling statistics were called for in connection with the Agricultural Census, and for the period covering 1st December, 1927, to 31st November, 1928, the main features of the returns are as follows:—

There were eight wheat mills operating during the year. The eight mills are capable of milling a total of 40.5 bags (200 lb.) wheat hourly. 89,633 bags wheat were milled during the year, producing 24,012 bags (200 lb.) fine flour and 41,934 bags (200 lb.) atta flour.

The wastage in milling (pollards, bran, etc.) was 23,687 bags of 200 lb. or 26.4 per centum of the total quantity milled.

Barley.

There was an increase in area from 4,093 acres in 1927 to 5,933 in 1928, and indications point to a considerable extension of this crop. Unfortunately, in areas known at present to be suitable for the crop the grain becomes discoloured on the ear before harvesting, due probably to mist and dew. That in itself may reduce the quality from " malting " to " feeding " value. Growers are realising the care which has to be exercised in the growing of a " malting " sample, but even at export values for feeding purposes the crop may be more profitable than wheat in districts where rust depreciates the wheat yield.

Good varieties of " malting " barley have been introduced from time to time, both by this Department and individual growers, and there is therefore available in the Colony suitable seed for extending the cultivation of this crop.

Coffee.

Labour difficulties in 1925 and 1926 arrested progress in the planting of new areas, but conditions in this respect have greatly improved and in 1928 the highest annual increase yet recorded was planted. The area under coffee increased by 9,511 acres, bringing the total area under this valuable crop to 84,073 acres. The season was not favourable to the production of a heavy crop and as compared with the previous year exports increased by 1,820 cwts. only. In value the coffee exported decreased from £1,140,549 in 1927 to £1,119,894 in 1928.

The total quantity of coffee produced in the last Agricultural Census year was 246,292 cwts., but the unfavourable weather conditions during 1928 are calculated to reduce considerably the yield of the 1928-29 crop, probably by about 50,000 cwts.

The importance of this industry to the Colony in reflected in the number of coffee growers and the proportion which the value of coffee exported bears to other crop exports.

The number of coffee growers has increased during the year from 749 to 829, representing 42 per cent. of all the European occupiers of land, and coffee exports represented 49.8 per cent. of the Colony's total agricultural exports.

Market prices of " coffees "—particulars of which have been given in the Agricultural Census Report—have remained high for a number of years and " Kenya Coffee " is not only maintaining but enhancing its reputation on the world's markets. The average value of coffee exported during the year was declared through Customs to be Sh. 109/02 per cwt.

Reference is made in the reports of the Senior Coffee Officer, the Mycologist, the Entomologist and the Agricultural Chemist, to the Departmental services which are being carried out for the benefit of this industry. While the Department is rendering all the assistance in its power, there remains much to be done. Apart from pests and diseases, it is seen, and even the best planters are now ready to admit it, that a great deal has yet to be learnt on the cultural side. The varying conditions in coffee-growing districts complicate the matter in so far as sound practice in one district is not necessarily suitable in another. Observations and experiments made by the Coffee Officer and by growers are, however, bringing forth an accumulation of experience which is proving to be of great value.

That dreaded pest of coffee-growing countries—the Coffee Bean Borer (*Stephanoderes*) was identified for the first time on a number of plantations. As the result of preliminary inspection work, it was decided to conduct an extensive campaign calculated to arrest its spread, if not to eradicate it, early in 1929 and preparations were accordingly made.

Tea.

The area under tea as at 31st July was 4,809 acres, an increase of 1,655 acres over the previous year.

In the year under review the first export consignment of factory prepared tea—86 cwts., valued at £678—was shipped. There is much promise that the industry will succeed in the Kericho and Limoru Districts, where considerable expenditure is being incurred upon planting and the erection of factories.

Doubts had been expressed as to the sufficiency and efficiency of African labour for the development of the industry, but those engaged in it are in the belief that any difficulties which exist can be surmounted by favourable conditions of employment and by good organisation. It appears to be already established that tea of good quality, commanding a satisfactory price on the tea market, can be produced.

Sisal.

As in the case of wheat and coffee, there was a remarkable increase in the area under sisal—the greatest annual increase so far recorded. That increase was 20,696 acres, bringing the total planted as at 31st July, 1928, to 91,909 acres, of which 48,621 acres were over 3 years old, and therefore ready for cutting.

Exports of fibre increased from 305,985 cwts. in 1927, to 330,315 cwts. and with prices remaining practically constant, the value of this export increased from £468,974 in 1927 to

£495,959 in 1928. From returns furnished the estimated production for the Census Year ending 31st July, 1929, is 365,000 cwts. as compared with an actual production for the previous similar period of 290,190 cwts.

Much skill and attention is given to the organisation of this industry and the marketing of the product, not only by the companies owning Sisal Estates, but by its representative organisation, the " Sisal Growers' Association," and success has been achieved particularly in reducing costs of production. Engineers and others are devoting attention to the design and manufacture of improved decorticating plant. If the experiment proves successful, and at present it so promises, methods of sisal production will be greatly changed not only in this Colony but elsewhere. The reports of the Agricultural Chemist and Mycologist deal with certain Departmental services rendered for this industry.

Sugar Cane.

The greatest increase hitherto recorded in the planting of cane occurred in 1928. There is now a total of 9,403 acres on European holdings, and 3,693 acres on farms occupied by Indians, making a total of 13,096 acres.

The output of crystallised and raw sugar fell from 179,748 cwts. in the season 1926-1927 to 128,944 cwts. in 1927-1928, and exports, chiefly to Tanganyika, dropped from 25,329 cwts. valued at £37,052 in 1927 to 11,941 cwts. valued at £19,258 in 1928. That decrease is to be accounted for by the effect which the drought had on the supply of cane, also to the reduction in sucrose content of the cane from the same cause.

Over a period of some years the progress of this industry has been slower than anticipated, but it should be remembered that it is one involving the expenditure of a large amount of capital. With the establishment of two new sugar mills, one near Nairobi and the other at the Coast not far distant from Mombasa, and the development now taking place in the planting of cane, it is expected that these efforts in Kenya, coupled with the output of the mill in Uganda, will ere long supply the demand in Eastern African Territories fully.

The increasing consumption of the native population, due largely to their increased purchasing power, is noteworthy, and it is felt that with a substantial reduction in the price of sugar this market could be considerably increased. Based on that, rather than on an export market, reliance should be placed by the industry during the initial years of its development.

This Department has been actively engaged in an endeavour to eradicate mosaic disease in the Nyanza Province by prohibiting the growth for a period of other than " Uba "

cane, which is resistant to this disease. In order to prevent the introduction of "mosaic" from other countries, while offering facilities for the introduction and testing of improved varieties, arrangements are in force for such imported canes to be grown in a protected enclosure under control at the Scott Agricultural Laboratories. The crop of plant cane thereform will be handed over to the importers, who will be charged only the costs incurred in growing the crop.

Coconuts.

Non-European interests in the cultivation of coconuts appears to be confined to individual needs for local consumption and European enterprise has not increased the plantation areas substantially during recent years, indeed there has been a slight decrease in the area so occupied, namely, from 8,113 acres in 1927 to 7,994 acres in 1928. Some copra is used locally for soap making. The export of copra nearly doubled itself in 1928, as compared with the previous year, the relative figures being 26,995 cwts. valued at £28,955 and 14,725 cwts. valued at £14,070. That increase is due to palms planted in previous years having now reached the productive stage.

Neither the Coconut Beetle (*Oryctes monoceros Ol.*) nor "Bud Rot" (*Pythium palmivorum*) appear to be increasing seriously in their incidence.

Essential Oils.

For some years past private enterprise centred at Njoro has experimented, chiefly with a variety of geranium, in the production of essential oils; 473 acres have now been planted, distillation has been carried out on a productive basis, and the oil is sold to a British firm.

Wattle.

The area under wattle (*Acacia decurrens*) has increased from 8,830 acres in 1025 to 9,922 acres in 1928, but it should be noted that during that period a considerable area was "barked" and cut down. There are 6,319 acres under the age of 6 years. The export of wattle bark has more than doubled during the last year, the figures being 44,082 cwts. valued at 17,338 in 1927 and 101,619 cwts. valued at £59,112 in 1928. The export of tannin extract remained practically constant; for 1928 it was 20,284 cwts. valued at £22,478.

The increase in export from this industry is due chiefly to the bark now supplied from the Kikuyu Native Reserve. The natives were encouraged to plant wattle trees chiefly for fuel

and shelter and the opportunity later arose for the bark therefrom to be marketed. Unfortunately, their methods of stripping and drying leave much to be desired with the result that unsatisfactory reports have been received in regard to the quality of the bark. Grading offers no solution as it is impracticable in the circumstances and the most promising method of overcoming a real difficulty is export in the form of tannin extract rather than of dried bark.

Miscellaneous Crops.

Little interest is now taken in flax, the area having dropped to 284 acres. Only stability in the flax market, and some assurrance that profitable prices could be secured, would persuade farmers to renew the cultivation of this crop. Castor, of which 965 acres were under cultivation in 1925, is disappearing—the area in 1928 being returned at 92 acres only. Some interest is being taken in tobacco, of which 187 acres were reported as having been planted as at 31st July, 1928.

The area under oats increased from 1,105 acres in 1925 to 2,572 acres in 1928. Only in a few districts has it been found so far that this crop " heads " properly for the production of grain.

Fodder crops, chiefly maize and oats, represented an area of 1,601 acres.

A large range of crops were referred to in Census Returns under the head Miscellaneous Crops. It covers buckwheat, turnips, cabbages and kale, carrots, mangel, onions, pumpkins, melons, sunflower, linseed, simsim, lupins, teff grass, rye, rice, millet, cassava, ginger, groundnuts, chillies, etc. The area under these covers 4,324 acres.

Certain of these crops are likely to be more extensively used as rotation and green manuring crops, and attention is being given to the growing of groundnuts as an economic crop which, however, may be dependent upon the use of harvesting machinery now available.

Live Stock.

Native live stock are dealt with under the title " Native Agriculture."

The total number of cattle in the possession of Europeans on the 31st July was 216,961, an increase of 1,311 or 0.60 per cent. as compared with the previous year.

The following table shows the numbers of live stock owned by Europeans during the last five years :—

	1924	1925	1926	19 7	1928
Cattle—Total	211,381	216,589	213,423	215,650	216,961
(*a*) Breeding Stock ..	110,855	110,547	105,556	107,434	110,796
(*b*) Oxen	100,526	106,042	107,867	108,213	106,165
Horses	1,642	1,846	1,844	2,137	2,172
Mules	985	922	780	719	709
Donkeys	1,213	1,336	931	1,046	1,238
Sheep (Wool-bearing) ..	133,916	140,725	162,848	172,299	176,261
Sheep (Native)	32,132	38,071	43,057	32,972	20,603
Goats	4,618	5,372	4,454	3,697	3,211
Pigs—					
(*a*) Breeding Sows ..	2,384	2,040	1,714	2,896	3,455
(*b*) All others	8,284	6,524	7,411	10,061	14,697
Poultry	38,910	31,150	35,728	43,988	38,845

These returns indicate that the serious drop in the number of breeding cattle, as revealed in the 1926 Census, has been arrested, and there is evidence of slight progress in cattle breeding. The decrease in the number of oxen is accounted for through their displacement by mechanical power.

This Colony participated in the helpful scheme of the Empire Marketing Board, and shared equally with that Board the cost of shipping freight on pure-bred stock imported from Great Britain. Great benefits should accrue to the live stock industry through the opportunity thus afforded for improvement by the use of pedigree sires. Under regulations approved by this Government and the Empire Marketing Board applications were granted in respect of 69 bulls, 16 cows and heifers, 32 pigs, 22 sheep. Only a limited number of these animals arrived in this Colony before the end of this year.

Notwithstanding the financial assistance so rendered, experience of importers shows that the total cost of the animals remains relatively high. As far as practicable the initial outlay has been reduced by amending the regulations whereby one year's insurance is acceptable instead of two, as originally laid down.

Particulars of pure-bred cattle imported during the last three years are as follows :—

	1926	1927	1923
Shorthorn Bulls	26	18	20
Friesland Bulls	4	77	13
Friesland Cows and Heifers	..	..	6
Ayrshire Bulls	9	10	17
Ayrshire Cows and Heifers	1	3	8
Aberdeen Angus Bulls	1	..	1
Jersey Bulls	2	..	..
Jersey Cows and Heifers	6	..	..
Polled Hereford Bulls	..	1	..
Black Welsh Bulls	..	4	..
Black Polled Angus Bulls	..	4	..
Guernsey Bulls	..	1	..
Welsh Bulls	..	12	4
Blue Albion Bulls	..	..	2
TOTALS	52	130	80
Total Bulls	45	127	66
Total Cows and Heifers	7	3	14

The increase in 1927 was due to the consignment by a private breeder of a large shipment of Friesland bulls for sale in this Colony. It is regrettable that a larger proportion of pure-bred females are not imporetd for the establishment of pure-bred herds, so that more pure-bred sires might be reared in the Colony and so that the heavy expenditure now incurred on importation might in part at least be saved.

Interesting statistical information in regard to the cattle industry is given in the Agricultural Census Report. Here it may be recorded tha of the " bulls in use " in herds in 1928, 32 per cent. were native, 45 per cent. were grade, and 23 per cent. were pure-bred.

The cattle industry is not making the progress expected of it, and the results are disappointing having regard to the efforts of breeders coupled with the protection from losses due to diseases afforded through an efficient Veterinary Service maintained at considerable cost. Those protective measures effected by regular dipping and many inoculations conferring immunity against disease are inevitably costly, both to the owner and the state. Due to the low average productive capacity of the cattle found in the Colony, both in respect of beef and milk production, the returns to the owner are not encouraging.

Again, many stockbreeders lack experience and the management of the herds leaves much to be desired. All these factors tend to retard progress. Considerable attention has

been given, with the assistance of the Stockbreeders' Consulting Committee and a Select Committee of Legislative Council, to the drafting of legislation dealing with cattle cleansing (dipping) and the fencing of farm holdings. Both of these measures, when enacted, are calculated to advance the industry; indeed, they may be regarded as prime factors essential to progress. The success which they achieve will largely depend upon the response made by owners of stock and occupiers of land to the provisions embodied in these Bills. Compulsory dipping should, in the course of time, greatly prevent the spread of tick-borne diseases and reduce the losses suffered, while the systematic fencing of holdings, including not only boundary fences but internal fencing creating sub-divisions of the farm, should enable farms to be cleared and maintained free of tick life, and in addition opportunities will be afforded for better management and greater use of the pastures.

The work on animal nutrition by officers of the Rowett Research Institute in conjuction with this Department to which reference was made in the 1927 Report, was completed during 1928 at three of the four stations at which experiments were being conducted. The findings of these workers have been published in two Departmental bulletins by Mr. Gunn: "Notes on the Effect of the Feeding of Mineral Salts to Grazing Animals" and "Notes on Nakuruitis".

The following table gives particulars of importations of sheep during the last three years:—

Year	Rams	Ewes
1926 ..	168	17—(176 Merino and 9 Kent or Romney Marsh)
1927 ..	87	10—(89 Merino and 8 Kent or Romney Marsh)
1928 ..	245	100—(202 Merino,*110 Black Head Persian,*4 Suffolk Down, 20 Dorset Horn, 3 Cheviot and 6k Kent or Romney Marsh)

* Imported by Government.

A steady improvement is being made in the grading up of sheep for the production of wool chiefly through Merinos, and the wool produced sells at satisfactory prices, due largely to the favourable conditions which exist for the production of wool, fine in type, and giving a "good yield," because of its freedom from grease and dirt. The supply of well-bred Merino rams is quite inadequate with the result that sheep-breeders have to resort to the use of grade rams which can only effect a slow improvement in the flocks. A great need is the importation of numbers of pure-bred Merino ewes, together with suitable rams

in each case of a quality high enough for the breeding of rams of the quality known as "flock." Few breeders possess a sound knowledge of the breeding and management of Merino sheep, the mating and classing of ewes, and the classing and "make up" of wool for the market. Much valuable service could be rendered to the sheep industry by an experienced officer skilled and technically trained in sheep and wool.

Marked progress has been made in the pig industry. A large increase is shown in the case both of breeding sows and other pigs. A corresponding increase is shown in the production of bacon and hams. It is considered that "saturation point" will shortly be reached in the industry, and that unless new markets are found outside Eastern African Territories a further increase in the number of pigs will create a glut in the local market. It seems to be a matter for those engaged in the industry seriously to consider what policy should be adopted, whether the industry should be confined to meeting local demands, in which case it cannot become one of great importance, or whether, and if so what, steps can be taken to develop new markets oversea. In order that the whole question may be fully examined steps have been taken to convene a Conference representative of those engaged in the industry.

Animal Products.

The following is a comparative table of the animal products sold by Europeans during the last five years :—

Year	Milk (Whole)	Cream	Butter	Cheese	Ghee	Bacon and Hams	Wool
	Gal.	*Gal.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*
1927–23	421,779	75,764	324,593	130,533	78,528	519,463	420,575
1926–27	617,747	92,640	216,863	143,305	124,057	No return	632,088
1925–26	395,031	72,693	291,894	144,070	115,815	430,119	670,752
1924–25	371,692	85,557	303,085	92,994	103,153	364,552	461,536
1923–24	372,103	107,669	252,990	93,248	112,815	..	427,266

The fluctuations in the proportions of the different kinds of dairy products sold as milk manufactured products are to be noted. The reduction in the supply of whole milk is probably due to unfavourable grazing conditions on account of drought.

Taking the ratio of :—

2.25 gallons milk to 1 lb. butter
1.1 ,, ,, ,, cheese
2.6 ,, ,, ,, ghee
3.2 lb. butter to 1 gallon cream

it is calculated that the primary product—milk—has decreased from 2,257,974 gallons in 1926-27 to 2,068,843 gallons in 1927-28, a reduction of 189,131 gallons or 8.3 per cent.

"East African Stud Book."

Meetings of the Stud Book Committee have been held. Volume IV has been compiled by the Editor and the applications for entry have been certified for publication by this Department, as required.

A sum of about £70 stands to the credit of the Stud Book Account, kept by the Agricultural and Horticultural Society, after the cost of publishing Volume IV has been met. It is important that the organisation of this service should be financially sound and that breeders should feel security in regard to continuity of publication of the Stud Book. There is, however, a paucity of pure-bred studs, herds and flocks, and unless more "pedigree" females are imported the scope of the Stud Book cannot materially increase. It does not seem to be fully realised that the registration of sires used only in non-pedigree herds, etc., is of little value in this connection.

Indian Agriculture.

The activities of Indian occupiers of land is confined (*a*) to a few indivdual holdings at the Coast which do not contribute anything of a substantial kind to production, (*b*) to a number of market gardeners engaged chiefly in supplying the Nairobi market with vegetables, and (*c*) to an Indian farming community settled in the Kibos-Miwani area. The latter is of some importance, and the land occupied is in process of development chiefly for the cultivation of sugar cane. Through the Nyanza Indian Farmers' Association, the following information has been furnished in respect to the operations of this community :—

Number of occupiers, 40. Area 4,217 acres.

Under sugar cane	3,693	acres.
Under maize	55	,,
Under other crops	32	,,
Cultivated but not planted	437	,,
Number of working oxen	1,234	
Number of other cattle	746	

In the last Agrictural Census Year 28,800 tons of sugar cane were cut and found its market chiefly at the sugar mill in the same district.

Native Agriculture.

This section of the Department's activities falls immediately under the control of the Deputy Director (Mr. E. Harrison), who reports as follows :—

" The full establishment of this branch for the year 1928 was ten, not allowing for officers on leave, and the average number of officers engaged on the work of this section during the year was nine. They were stationed as follows :—

Nyanza Province.—Mr. A. G. Bailey, Bukura School and Central Kavirondo; Mr. R. G. Bentall, Bukura School and cotton areas; Mr. C. G. Bishop, South Kavirondo.

Kikuyu Province.—Mr. W. L. Watt, Mr. S. Gillett, Scott Agricultural Laboratories and South Kikuyu Reserve; Mr. W. G. Leckie, Embu; Mr. C. B. C. Handley, Meru; Mr. C. O. Oates, Fort Hall.

Coast.—Mr. H. J. Taylor, Digo to Malindi.

Mr. Lathbury, Agricultural Officer, was transferred to the Njoro Plant Breeding Station.

Mr. Spranger, Assistant Agricultural Officer, was transferred to the Njoro Plant Breeding Station.

Mr. Booth, Agricultural Officer, was employed on inspection and on locust work.

Mr. Handley, Assistant Agricultural Officer, left Meru in July, and was replaced by Mr. Sunman, Assistant Agricultural Officer.

Mr. Taylor, Assistant Agricultural Officer, proceeded on leave in September, and his place at the Coast was taken by Mr. Oates, Assistant Agricultural Officer, Fort Hall being left without an officer.

Mr. Bishop, Assistant Agricultural Officer, proceeded on leave in October, and South Kavirondo was left without an officer.

Mr. Leckie, Assistant Agricultural Officer, proceeded on leave in October, and was replaced by Mr. Hartley, Assistant Agricultural Officer.

To supplement the work of these officers, 51 native agricultural instructors were employed, and were distributed as follows :—

Nyanza Province.—12.—North and Central Kavirondo, 11; South Kavirondo, 1.

Kikuyu Province.—26.—South Kikuyu, 11; Fort Hall, 5; Embu and South Nyeri, 7; Meru, 4.

Coast.—13.—On Coast, 12; Voi, 1.

For 1929, the Department has secured provision for four additional Agricultural Officers, to be distributed as follows: Coast, 1; Kerio Province, 1; Nyanza, 2; together with twenty additional native instructors. This additional staff should enable continuity of work in the three main Provinces, the effects of the period of officers' leave being less severe on the organisation.

The housing of departmental officers in native areas leaves very much to be desired. An officer who spends a great deal of his time on *safari* needs comfortable and healthy accommodation at his station.

The Department maintains two schools of instruction in order that trained native instructors may be available for its own demonstration work as well as for Local Native Council efforts and for Mission Schools at which gardening is taught.

The Department maintains 106 demonstration plots throughout the reserves. The tendency will be to reduce the numbers and to increase the size in order that more acclimatised seed will be available for issue. In addition, a new method of management will be tried in one area whereby the Department will in effect maintain a peripatetic school, moving from plot to plot mainly for the purpose of demonstrating ploughing, planting and after-cultivation. Native seed and grain storage in reserves is still in an unsatisfactory condition.

Issues of seeds and plants are being made in much larger quantities from the two schools, and poultry issues are increasing, due mainly to the extension of poultry breeding at the Scott Laboratories.

Seed is purchased by the Department for issue in districts where it is desired to improve seed stocks and to demonstrate the value of mass issues of good seed. Local Native Councils are now more largely interested in good seed issue, and relatively large sums are voted each year by these Councils for the purchase of seed for their particular district. In Central Kavirondo, Local Native Councils are providing money for instructors. Likewise, native people are purchasing numbers of Rhode Island Red cockerels, and are themselves carrying out the operation of culling *shenzi* cocks. There is a growing demand for this breed of bird, a breed whose introduction it is believed has been everywhere uniformly successful. It is strongly recommended that no other breed be introduced into native reserves for a number of years. The expenditure of a comparatively small sum of money annually on this class of

live stock has not only commenced the improvement of the mass of poultry kept by the people, but at the same time has been a most potent demonstration of the value and effect of good male stock in native flocks. Inferences are being drawn by natives, and ere long the desire to improve the other kinds of stock will become more manifest. A large trade should eventually arise in all kinds of improved stock—sheep, goats, cattle, and poultry—and it is possible to conceive that within a few years, unless early steps are taken to breed the quantities necessary, there will be no means of meeting the demand. A number of prue-bred Persian rams and ewes were imported, and are to be used in breeding and flock improvement. Instructions were issued to officers to give demonstrations wherever possible on the shade-drying of hides, and a large number have been given.

Cultivation on a much larger scale than heretofore can readily be observed. We estimate that in South Nyeri and Fort Hall the increase in cultivation in one year is perhaps forty per cent. One might here mention the great value of the aeroplane in revealing the extension of cultivation in a country which is so broken into ridges that it may not be properly overlooked from high points. If only because an aeroplane flight over a reserve gives a conception of its extent, the position of the grazing areas, trees, the density of cultivation, and so forth, such flights should, it is thought, be regularly taken by District Officers and Agricultural Officers. There are other things which may be observed, but the one or two mentioned are, it is considered, sufficient to justify the few flights necessary. Efforts should continue to be made to introduce a greater variety of crops into reserves, but only after careful trial in the experimental plots. Importation of the seed of pulses and other crops should be made, particularly from India.

Native people are much more readily taking to ploughing. In Central Kavirondo, where ploughing competitions have been one of the features of the Native Shows, there is a steady demand for ploughs. In Fort Hall the Local Native Council is doing excellent work in introducing these implements. So many factors influence these advances that one may say they are a natural outcome, but one would wish to mention the unabated enthusiasm of many Administrative Officers in connection with the introduction into reserves of labour-saving and, incidentally, cultivation-extending appliances.

The time is coming when the Native Reserves will be looked upon in part as native estates rather than as areas of native occupation. It is recognised in Africa, but not so well recognised elsewhere, that native people vary greatly in capacity, ability and energy. This Colony does not produce

natives of the type met with in Uganda, Zululand, the West Coast; our people are far less advanced. However, native people are developing quickly, the effects of contact with modern methods and conditions will be more largely revealed in the coming generation; the areas they inhabit should also develop rapidly, but as a mass the people are neither wealthy enough nor sufficiently interested or informed to carry out the development.

More attention should be paid to the development of irrigation, particularly in the arid areas, and the head-works and main furrow should at least be permanent. The management of land under irrigation is not easy, and no doubt many problems, both administrative and agricultural, will arise. The possibility of " problems " should not deter development. Many native districts in which famine occurs at intervals, include areas suited to irrigation by means of schemes on a moderately large scale, but the people have not the means to develop them. In the past excellent work has been done by Administrative Officers, generally unaided, in the development of small schemes, costing little or no money, and their efforts should be followed up and more difficult projects tackled. Kerio and the areas to the east of Mount Kenya especially require attention. Water-boring, so long advocated, is now possible, and is being prosecuted.

Another matter affecting the progress of native production is the uneven distribution of the population. In North Kavirondo native people can be found as thinly domiciled as thirty to the square mile, and as densely as 1,000 per square mile. It is clear that with a pressure so high as one thousand there can be but little surplus, recollecting that there are practically no industries save agriculture. Large acreages of country similar in many respects to that so densely occupied can be found 60 to 100 miles north. Some effort at securing migration should be made, even if expenditure on some scale is incurred. An opportunity for the establishment of improved villages presents itself if only the people could be induced to venture and migrate.

To what extent the system of tenancy common in the Kikuyu Reserve is responsible for the curtailment of production cannot be estimated, but it is surely wrong that a family, in order to secure enough land to cultivate, should have to journey from one small patch to another some miles distant, and to yet another.

Stock problems are ever with us, and are constantly under examination. During the year the Committee appointed to make recommendations regarding the utilisation and improvement of native stock presented its report.

As has been pointed out so frequently, natives regard live stock, particularly cattle, as a bank, and, as their accumulations increase, more land has to be found for the stock, or the limited land is trodden and grazed until its value is much deteriorated. As the native becomes wealthier are we to expect a curtailment of agricultural work due to "bank" accumulations needing the grazing? This is a most pressing problem, and unless outlets for these accumulations are provided, or they are in some way prevented from increasing, some native reserves will all too soon be inadequate to the "needs" of their inhabitants. The accumulation of very low value live stock may in time threaten the very existence of the tribe; in other words, natives will be overwhelmed with their "wealth," as natives apparently have not the wit to restrict it or to find some other form of investment. Heavy stock taxation for all animals in excess of a certain minimum per married woman may have an effect; on the other hand it might easily result in generally reduced production of saleable commodities as well as have other serious manifestations. Quite possibly, in heavily stocked areas, we may have done quite the wrong thing by inoculating all live stock to prevent loss, and we might easily use inoculation as the means of saving the better class of stock by refusing to inoculate poorer types; there is, unfortunately, something of injustice in such a policy, however useful it may be in correcting the evil. There is no manner of doubt that as regards native live stock in parts of Kenya we are making but little headway, and appear to have problems similar to those existing with native live stock in Southern Africa.

Numbers of Live Stock Owned by Natives (Estimated).

The following figures are extracted from the Agricultural Census Report for 1928:—

Cattle	3,265,000
Sheep	2,650,000
Goats	3,650,000
Horses	200
Mules	300
Donkeys	35,000
Camels	60,000

There is evidence to show that cattle, sheep and goats show a steady if small annual increase, but in the circumstances it is possible only to quote approximate figures; those representing cattle are known to be well underestimated.

It is not generally realised that production by natives demands the introduction of but little capital, and the potential energy of the people, together with a modicum of sound

direction, is capable of largely increasing the annual trade returns of this Colony. This, it is believed, may be accomplished without much interference with the extent of the activities of any other section of the community. Whilst the time may not be ripe for the introduction of plantation crops, there is no doubt that, properly organised, such crops will be produced in the future in co-operation with Europeans and otherwise. One very promising plantation industry of especial value to the Kikuyu, who are short of fuel supplies, is the culture of the black wattle, chiefly in small patches and as windbreaks. Export of dry bark and the supply of green bark to the extract factory has already commenced. The great difficulty regarding plantation industries is the necessity of getting the crop planted in advance of the provision of the factory for its treatment. Large areas near the forest around Mount Kenya are suitable for wattle and other plantation crops, but at present there is no certainty that factories will be provided when required.

The returns of exports leaving Mombasa calculated as being of native origin do not show great expansion over the past three years, but in common with the rest of the Colony native areas, as a whole, have not enjoyed good seasons. Furthermore, we have evidence that many native products are not so largely exported, but to an increasing extent are consumed within the territories. Kavirondo maize, formerly exported in large quantities, is now being ground into flour at Kisumu. Simsim too is not all being exported as such, but crushing is taking place more extensively within the Colony. Railway works in Kikuyu and Nyanza Provinces, together with the provision of many new bridges and better roads,—all having, or will have, their influence.

The Schools : Scott Laboratories and Bukura.

At the two institutions the training of pupils was brought into line, the period of training being extended to three years.

During the year the Committee appointed to make recommendations on the agricultural training of natives presented its report. It was recognised that higher training would have to be undertaken by the Department of Agriculture, whilst the desirability of all native teachers being taught elementary agriculture and nature study made it imperative that the subject in its elementary form be part of their curriculum. Therefore the Department of Education would have to provide facilities for such training at its secondary schools. Until that Department is in a position to offer the essential preliminary training this Department must provide courses of instruction of a more elementary nature, and also must undertake to make up the deficiencies in the general education of its pupils. It is gratifying to know that the subject of agriculture is to be

given prominence in the education of the African, and that the Department of Education is anxious to relieve this Department of the necessity of maintaining schools at which, besides agriculture, a large number of other subjects have to be taught, such as reading, writing, Swahili, mathematics, and geography.

Missions have also recognised the importance of agricultural education, and are more than ever anxious to develop this side of school work. The demand for native teachers who are able to teach elementary agriculture and nature study, and who will establish useful school gardens, is now much greater.

The importance of native pupils paying part of the cost of higher training has not been lost sight of, and small fees will be charged when the number of pupils offering is greater than it is to-day. Free education, with free maintenance, together with a small monthly rate of pay, is the inducement which to-day brings pupils to the schools; the possibility of securing a moderately well-paid position after training will in the future interest a better and possibly a more independent type of boy. It is not difficult at present for any smart native to learn to drive a motor truck, secure a driver's licence, and then demand and secure a monthly rate of pay greater than that earned by many trained native teachers.

PUPILS AT BUKURA AND SCOTT LABORATORIES—
NUMBERS IN TRAINING AND EMPLOYED.

	Number of Pupils at		Number sent out trained	
	Scott Labs.	Bukura	Scott Labs.	Bukura
1923.. ..	21	..	..	..
1924.. ..	42	30	..	..
1925.. ..	43	32	10	..
1926.. ..	34	55	28	..
1927.. ..	42	45	..	9
1928.. ..	50	36	8	4

No pupils completed course at Scott Laboratories in 1927 owing to lengthening of course from two to three years. Of those passed out—

Scott Laboratories :

1925.—10 : 8 as Instructors.
1926.—28 : 14 as Instructors.
3 as Mission Teachers.
4 Trading.
7 Other Occupations.
1928.— 8 : 4 Plant Breeding Assistants.
3 Instructors.
1 Native Chief.

Bukura :

1927.— 9 : Engaged as Instructors by Local Native Council.
1928.— 4 : 2 as Teachers; and
2 as Clerks.

Weather Conditions.

Nyanza.—The rainfall was favourable for both long and short rain crops. The long rains were too heavy for good bean crops. Hail was experienced in July and August.

Kikuyu.—Rains were late and badly distributed, falling over too short a period. The short rains commenced late, and whilst they lasted were good, but ceased too soon, so that crops were not up to expectations. Better crops were secured in the locations high up the slopes of Mount Kenya.

Coast.—In only a small area were the long rains good; very dry weather with dry high winds was experienced in July. The short rains were late in breaking, but were fair.

Seeds, etc., Supplied from Departmental Votes.

Provinces	Kikuyu	Nyanza	Kerio	Ukamba	Coast	Total
	lb.	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*
Maize	56,810	33,000	4,800	6,000	900	101,510
Wheat	29,210	400	200	1,200	..	30,810
Simsim	12,360	4,000	200	120	9,600	26,280
Beans	11,461	..	900	3,200	..	16,561
Groundnuts	9,200	15,050	..	240	..	24,490
Peas	534	..	..	..	..	534
Linseed	380	..	..	..	..	380
Fruit Trees	52	10	18	..	..	80
Potatoes	3,000	3,000	..	..	..	6,000
Njahi	90	..	..	..	..	90
Bananas	42	..	..	..	..	42
Rice	1,400	..	..	180	200	1,780
Buckwheat	..	5,850	..	..	..	5,850
Chiroko	..	4,800	960	..	..	5,760
Chillies	..	..	..	..	200	200
Wimbi	..	..	9,000	..	..	9,000
Matama	..	..	3,180	..	..	3,180
Vegetable Seeds ..	30	20	..	100	30	180

ISSUES OF SEEDS AND POULTRY FROM SCOTT AGRICULTURAL LABORATORIES AND BUKURA.

	Scott Laboratories	Bukura
	lb.	*lb.*
Maize	33,410	18,000
Simsim	..	1,000
Groundnuts	..	2,640
Beans	1,621	200
Gram	..	150
Peas	14	..
Potatoes	3,000	..
Njahi	90	..
Wheat	1,210	..
Fruit Trees	28	..
Bananas	42	..
Rhode Island Reds—		
Cockerels	157	..
Pullets	108	..
Eggs	22	..

ISSUES OF SEEDS SUPPLIED FROM LOCAL NATIVE COUNCIL VOTES.

	Nyanza	Kikuyu	Ukamba	Coast
	lb.	*lb.*	*lb.*	*lb.*
Maize	8,000	..	..	18,000
Groundnuts	7,800	..	60	..
Beans	..	..	..	3,750
Simsim	..	..	120	..
Vegetable Seeds ..	..	..	..	30

A perusal of the tables will show that many tons of seed are sent into native reserves to regenerate stocks and provide a more uniform harvested sample. This work should be put on a more satisfactory basis as regards supplies. More acclimatised seed should be used and to this end seed-producing plots for the commoner seeds used should be extended or established in many reserves. Seed grown on the spot is much cheaper, costs little for transport, and often gives better results than seed purchased many miles from the reserve in which it is to be used. Difficulties in connection with the establishment and management of seed plots are being overcome.

IMPLEMENTS, ETC.

Apart from the introduction of iron implements, jembies, fork jembies and ploughs, there are further possibilities in connection with tillage implements and food-grinding machinery. In addition, the erection of more permanent seed

stores for individual natives should receive much closer attention and encouragement. The present system of using wickerwork plastered with mud has its advantages in that the store is cheap; but it is a harbourage for weevils, and frequently may be entered by rats and mice. Also these wicker stores are prone to burst or lean over, so that rain enters. It is felt that natives would purchase tanks or make large brick bins if they knew more about it, and could be convinced as to the quantity of food they lose annually as a result of poor storage.

Crops.

Maize is perhaps now the staple crop produced, although enormous quantities of matama are grown, and rightly so. The area of the Colony in which matama may be grown successfully is far greater than that in which maize may be grown, and especially as the rainy seasons are so short matama is more likely to give a good yield. A strain of flint maize suitable for native planting has been isolated. More attention should be given to selection work with quick maturing yellow and white maize varieties. There is no need for a 40-day maize; what is needed is a good 120-day maize. Issues of such maize have been made, but the varieties are not so successful as is required. We have mainly issued maize which takes a long time to mature, say 200 days, and despite everything wonderful crops have been grown, but there is a large population which does not inhabit country suited to such a slow maturer. Large quantities of maize are sold annually by native people.

Cotton.

The culture of this crop is not increasing greatly. It is undoubtedly the best revenue crop natives can grow in the locations bordering on Uganda, although they are more inclined to simsim, which does not return more than half the money per acre. Efforts have been continued to increase the acreage planted in Kavirondo, and to improve cultural methods, with some success, but the 10,000 bale crop is a long way off.

On the Coast, at Malindi and Mambrui, again production does not greatly increase, although acre returns of over 1,000 lb. of seed cotton have been realised. There are many thousands of acres in these districts over which an average crop of 600 lb. could be harvested, but through indolence and carelessness a restricted area is planted and a subnormal crop is produced.

Prices paid for the 1927 crop sold in 1928 were 20-17 cents per lb. for " A " quality, and 9 cents for " B " quality cotton. 1,250 bales were produced in Kavirondo; 210 bales were produced in Taveta and on the Coast.

The crop in 1928 was better handled and an increase in production is looked for. The standard of planting and cultivation has improved, and Administrative Officers have, where possible, helped the Agricultural Officer to inculcate better methods.

Simsim.

Prices have ruled good for simsim, and natives are maintaining if not increasing the area planted to this crop. It has been introduced into the drier country of the Kikuyu Reserve near the Tana River.

Groundnuts.

Increased issues of seed of this crop have been made. It is particularly favoured in South Kavirondo. Natives are prone to harvest prematurely, and traders, it is found, have encouraged them to do so. In order to check this practice it is proposed to prohibit sale prior to a date by which experience has shown the crop is sufficiently mature to be harvested and sold.

Wheat.

The cultivation of this crop is extending. It is regarded as a new food crop, and no doubt will take its place in native agricultural practice.

Beans.

Of all crops grown by natives, the bean crop is the most mixed. As it is used as a food crop and a renovating crop, the native is not much interested in the uniformity and yield of the crop. Beans are purchased in some quantity for local feeding and a little for export. It is possible to do for beans what has been done for maize, but it is hoped that natives themselves will learn to plant good and uniform seed only and thus effect improvement in the quality of the produce.

Peas.

A crop grown on a small scale. This crop could be developed with advantage.

Potatoes.

Now that seed of acclimatised varieties is available, issues to various areas are possible and have been made.

The weakness is that valuable seed is generally issued direct to natives instead of being multiplied further in a seed plot in the reserve. The increased value of an issue treated in this way would more than compensate for the additional work entailed, and it must come about shortly as one of the recognised activities of agricultural officers that large seed plots managed by them be established at convenient and suitable points.

Rice.

In Kavirondo, on the Coast, and in Meru, efforts to popularise or extend the area of crop grown have been made in the past. It is not possible to record progress for the very simple reason that yields are so low and risks so great. Crops at Mumias expand and dwindle. The Meru native has tried and been encouraged again, whilst on the Coast maize is found to be much more certain, and is therefore a more popular crop than is rice.

Where local demand arises for a crop the Department, where represented, endeavours to meet the need by means of seed issue and demonstration.

Native Agricultural Shows.

The Department provided money for the reconditioning of the buildings on the present showground in Central Kavirondo at Maseno. A show was held on October 30th, the prize-money being provided by the Department.

On the Coast, the two shows which had been organised were not held, as the adverse weather conditions had so affected the produce that a show was out of the question.

A number of natives from every province attended the Agricultural Society's show held in Nairobi, at which a special native produce section was organised in order to take the place of the native show which was to have been held at Kiambu.

Pests.

The main pest in reserves this year has been the locust, both in the flying and the hopper stage. Fortunately, the hopper stage was confined mainly to pastoral areas, and therefore the amount of crop destruction directly due to hoppers was not great. Flying locusts in 1928 did not do much damage to native crops. The main damage was done after the close of the year, when crops were ripening, but the extent of the damage done is fortunately relatively not great. The work that natives have done to combat this pest is noteworthy, and every credit should be given to them and to the Administration for their activity in the matter.

The stalk borer, so successfully combatted in the Nakuru District by the European farmer, is responsible for loss, particularly on the Coast. Native cultural methods, and the fact that cultivation is scattered in patches all over a reserve, do not permit of the degree of control which can be exercised when the cultivation is in large blocks, easily overlooked.

Striga weed in Kavirondo has received attention, and its dangers are well known to the natives. Difficulty is always experienced in getting them to exercise the supervision and forethought necessary to combat this weed.

Finally, one would recommend that the individual reports of the officers working in the different areas be read and studied. These officers are working oftentimes under great disadvantages, personal and practical, and they need every encouragement in what is at times a difficult task.

One would like to mention the very great interest taken in native agriculture by many Administrative Officers, and would recognise the great help and encouragement they are to Departmental officers in the field and to the Department itself. There is now a generally unanimous demand for the services of Agricultural Officers by District Administrative Officers, to whom finally the credit for any success achieved must be mainly due.

It is always a matter for regret when the Department finds itself, through lack of staff or funds, unable to assist to the fullest possible extent in the development of a district."

NATIVE AGRICULTURAL EXPORTS.

THE ESTIMATED VALUES OF AGRICULTURAL EXPORTS OF NATIVE ORIGIN FOR THE LAST SEVEN YEARS ARE SHOWN HEREUNDER.

	1922	1923	1924	1925	1926	1927	1928
	£	£	£	£	£	£	£
Animals	1,200	10,000	20,000	16,000	11,000	12,000	11,000
Copra and Coconuts	12,000	10,280	35,000	28,000	20,600	12,000	23,000
Cotton	..	..	11,860	41,000	32,750	15,000	24,000
Groundnuts	20,000	24,000	26,000	19,000	31,000	22,500	19,659
Maize	73,000	120,000	130,000	100,000	70,000	75,000	*50,000
Millets	1,000	4,000	300	865	2,750	3,350	423
Pulse	7,000	12,000	15,000	16,000	20,400	19,900	13,000
Simsim	4,800	22,000	84,000	65,000	76,500	67,350	27,355
Hides	45,000	60,000	121, 00	210,000	140,000	160,000	200,000
Skins	5,000	3,000	30,000	50,000	51,000	56,000	100,000
Oils—Simsim	..	2,400	2,200	3,000	5,500	3,550	5,000
Potatoes	5,000	3,000	4,000	4,000	7,250	7,500	7,000
Miscellaneous	1,000	1,000	1,000	1,000	2,000	2,600	2,000
TOTALS £	176,000	271,680	480,360	564,865	470,750	497,780	482,437

* This figure is an estimate, the accuracy of which it is not possible to vouch for.

VETERINARY DEPARTMENT.

(A) ADMINISTRATIVE AND EXECUTIVE DIVISION.

For the protection of the live stock industry against the many diseases which are so prevalent in the Colony, Veterinary Services are provided on an extensive scale, and the large volume of work undertaken is revealed in the comprehensive report of the Chief Veterinary Officer.

Expenditure and Revenue.

The total expenditure in respect of Veterinary Field Services during the year 1928 amounted to £48,852, an increase of £6,962 as compared with the expenditure of the previous year.

The revenue collected during the year under review amounted to £16,877, a decrease of £5,523 as compared with the amount collected during 1927.

The decrease in the amount of revenue collected during the year 1928 is attributable to the prolonged conditions of drought which prevailed in all native reserves throughout the year. Consequently the number of cattle submitted by natives for immunisation was considerably less than in previous years. It will be observed from the revenue statement published elsewhere that the decrease in revenue is entirely in respect of veterinary services in native reserves and at veterinary quarantine stations.

Rinderpest.

The following summary indicates the number of rinderpest inoculations carried out by the field staff in all areas during the year :—

Rinderpest Inoculations during the year 1928.

	Double Inoculations	Virulent Blood Tests	Serum Alone Inocs.	Mortality Al Areas
In Settled Areas by District Staffs	14,548	..	..	..
In Settled Areas by Rinderpest Service	82,637	15,246	..	..
In Native Reserves and at Veterinary Quarantine Stations ..	59,296	10,757	73	..
Total ..	156,481	26,003	73	3,170

The field conditions under which rinderpest inoculations are carried out continue to compare favourably with those existing in other countries, and the percentage of mortality resulting from the immunisation remains approximately the same as that of the two previous years.

It is of interest to note in connection with immunisation against rinderpest that the first request for the compulsory double inoculation against rinderpest was received from the District Committee, Trans Nzoia. During the last two months of the year under review, 50,000 head of cattle were dealt with in that district.

The number of outbreaks of rinderpest reported during the year was in excess of those reported during the previous year.

East Coast Fever.

The number of reported outbreaks of this disease within "clean areas" during the year 1928 was fifty-one. This number represented an increase of seven outbreaks over those reported during the preceding year. In spite of the small increase in the number of outbreaks, the position with regard to this disease may be considered as generally satisfactory, as many farms, especially in the northern clean area, have been freed from East Coast fever.

Contagious Bovine Pleuro-Pneumonia.

There was a decrease in the number of outbreaks of this disease. During 1928 the outbreaks reported number eight, whereas during the previous year twenty outbreaks were recorded.

The free issue of pleuro-pneumonia vaccine to stock-owners was continued throughout the year.

Heartwater.

Outbreaks of this tick-borne disease have been reported from six settled areas, and the disease is apparently more prevalent than is indicated by the actual number of reported outbreaks. The eradication of ticks by systematic dipping is the only method of controlling the disease.

Other Diseases.

The technique of immunisation of cattle against bovine piroplasmosis and anaplasmosis and descriptions of typical reactions are described fully in the report of the Chief Veterinary Officer.

There is a decrease in the number of outbreaks of trypanosomiasis, blackquarter and ulcerative lymphangitis reported during the year 1928 as compared with those reported during the previous year.

Increases in the number of outbreaks are reported in respect of horse sickness, anthrax and contagious bovine abortion.

Veterinary Services in Native Reserves.

The instruction of pupils at Ngong Veterinary Training Centre in dairying, veterinary procedure, and the correct methods of flaying and shade-drying of hides was continued throughout the year. Pupils from the Turkana, Samburu, Masai and Central Kavirondo Native Reserves were accepted for tuition.

During the year under review, 59,296 head of native-owned stock were double-inoculated against rinderpest, and 10,757 head were tested on their immunity to rinderpest at veterinary quarantine stations in native reserves. The vaccination against pleuro-pneumonia of 36,206 head of native stock was also carried out at veterinary quarantine stations during the year.

A comparison of the figures of rinderpest inoculations in native reserves during the years 1927 and 1928 indicates a reduction in respect of the latter period. This reduction is accounted for by the low condition of the stock in the areas concerned due to conditions of drought which made the native owners reluctant to bring their cattle for immunisation.

The Preparation of Hides and Skins.

Educational work of a systematic kind in connection with improved methods for the preparation of hides and skins for export was continued throughout the year at veterinary stations in the Central Kavirondo Native Reserve, and in other native reserves instruction in this direction is given as opportunity offers.

Slaughter Stock.

The returns in respect of stock slaughtered at Nairobi and Mombasa during the last four years are appended :—

	1925		1926		1927		1928	
	Nairobi	Mombasa	Nairobi	Mombasa	Nairobi	Mombasa	Nairobi	Mombasa
Cattle	13,331	5,337	10,427	4,491	10,811	5,663	12,107	5,915
Sheep and Goats	19,248	18,598	20,901	19,457	23,685	19,910	27,610	18,988
Pigs	672	..	784	..	929	..	1,139	..
Calves	..	..	..	..	465	..	..	..
Other Animals ..	..	..	..	..	..	..	113	..

No records are available of the numbers of stock slaughtered for meat in other centres nor in native reserves and on estates.

The demand for meat in the Nairobi area steadily increases as is indicated in the above table.

The Branding of Stock Ordinance.

During the year under review 121 brands were registered, a decrease of 50 per cent. as compared with those registered during the previous year. Five registered brands were transferred to other owners, and one registered brand was cancelled. Sixty " S " branding irons for the branding of squatter stock were sold to the public.

(B) DIVISION OF VETERINARY RESEARCH.

Technical Routine.

(*a*) *Preparation of Laboratory Products.*

The quantity of the various laboratory products issued during the year are shown in tabulated form.

(*b*) *Routine Diagnosis.*

Includes the examination of smears and specimens forwarded for examination, the total number for the year being 5,782, details of which are shown on the tabulated sheets.

RESEARCH.

(A) Rinderpest.

(1) The breeding and rearing at Kabete of virus makers free of redwater-gallsickness and other tick-borne diseases for the production of " clean " virulent blood for the immunisation (simultaneous method) of dipped stock was commenced.

As a temporary measure until the " clean " virus makers are of a suitable age, cattle of about 15 months purchased from an estate on which short interval dipping is regularly carried out are being utilised. The blood of each animal is first tested on its infectivity to newly born calves which are kept tick free from birth and if found not infective the virus maker is used when required for producing blood for the inoculation of dipped cattle.

(2) *The substitution of rinderpest blood kept at 0° C. for fresh virulent blood.*—Owing to the difficulty frequently experienced by Veterinary field officers in obtaining supplies of rinderpest blood and more particularly blood free of tick-borne diseases for the immunisation of dipped cattle, it was considered desirable that the laboratory should arrange for the supply of all rinderpest virus required in the field and it was decided to

issue in some instances blood at 0° C. for use up till approximately 24 hours after the hour of bleeding. Several thousand doses of blood packed on ice were issued for the immunisation of dipped and undipped cattle. A number of the animals were subsequently tested on their immunity with fresh virulent blood alone, or with fresh virulent blood and simultanously anti-serum. On some estates the cattle proved to be immune; on others a percentage were found susceptible and it was decided to discontinue the use of other than fresh virulent blood pending further experimental inoculations to determine the efficacy or otherwise of blood, bled on different days of the temperature reactions, kept at 0° C. and used up till 24 hours after the hour of bleeding, and simultaneously various index doses of anti-serum.

(3) *Inoculation of 24 and 36 hours old blood kept at 0° C. and 24 hours later anti-serum.*—Inoculation of the virus 24 hours prior to the anti-serum invariably resulted in a reaction to rinderpest. Should this method of immunisation be practical, further experimental inoculations should be carried out under field conditions.

(4) *The substitution of nasal secretion of a rinderpest reacting beast for virulent rinderpest blood.*—Nasal secretion may be substituted for virulent blood for infecting "clean" virus makers, thereby eliminating the risk of transmission of redwater and gallsickness. Nasal virus was used for the immunisation (simultaneous method) of imported cattle susceptible to redwater and gallsickness. Precautions should be taken not to use nasal secretion collected from a rinderpest infected beast during the later stage of the temperature reaction.

(5) *Observations on the immunisation (simultaneous method) of imported cattle.*—Several head of imported (South African and British) cattle were submitted for rinderpest immunisation (simultaneous method).

Some of these animals were susceptible to redwater and gallsickness; others were recovered redwater-gallsickness beasts; others had recntly recovered from redwater and gallsickness immunisation. With a view to reducing the risk of severe reactions, high index doses of anti-serum were given. Simultaneously fresh nasal virus was inoculated to the animals susceptible to redwater and gallsickness and fresh virulent blood or 20 hours old blood kept at 50° C. to the recovered animals and fresh virulent blood to the recently immunised beasts. In some instances, fresh nasal virus, fresh virulent blood and 20 hours old blood failed to produce a reaction in highly susceptible imported cattle when simultaneously inoculated with a high

index dose of anti-serum and it was necessary to re-inoculate the non-reactors by the simultaneous method or inoculate with fresh virulent blood alone to produce a reaction to rinderpest.

Treatment of reacting animals by inoculation of a large dose of anti-serum approximately 24 hours after the rise of temperature was apparently of value in controlling the reaction.

Rinderpest immunisation, by the simultaneous method, of imported cattle recently recovered from redwater and gallsickness immunisation is not recommended, owing to the risk of recurrences of these infections consequent on the rinderpest reaction.

The risk of severe reactions which occur in highly susceptible cattle may be reduced by using a high index dose of anti-serum and simultaneously nasal virus and inoculating a further dose of anti-serum 24 hours after the rise of temperature, but in some instances as mentioned above, susceptible animals fail to react and re-inoculation has to be carried out. The simultaneous inoculation of a smaller dose of anti-serum, *e.g.*, 30 c.c. per 100 kilos body weight and fresh nasal virus and a dose of anti-serum 200—250 c.c. approximately 24 hours after the rise of temperature is being investigated with a view to eliminating non-reactors.

(6) *Prophylactic Vaccination.*—Further experimental inoculations were carried out by the Chief Veterinary Research Officer, which with the results obtained, are recorded in detail. So far the results show that several days after two or three inoculations, less rarely after one inoculation, of non-virulent toluol spleen extract of a *reacting* virus maker, a resistance against subcutaneous inoculation of 2 c.c. citrated fresh virulent blood is conferred. The resistance may be partial or complete. The period for which a complete resistance is conferred varies, it may be partial or still complete approximately three months after vaccination. The potency of different spleen extracts varies and to obtain an extract of uniform potency a number of extracts should be pooled and the index dose of the pooled extract determined by inoculating a large number of susceptible cattle with varying doses; one, two and three inoculations respectively at intervals of 7 days, and the cattle tested on their resistance to fresh virulent blood 7—14 days later.

Toluol spleen pulp of a *recovered* virus make was found to confer little or no resistance to contact infection. Spleen pulp of a serum maker completely protected two animals and partially protected a beast which received the same dose which conferred complete protection in another animal. Chloroform spleen extract of a virus maker, whose spleen was collected at the termination of the temperature reaction on the day the temperature had returned to normal, conferred little or no

resistance. Cattle inoculated with chloroform extract of minced organs of a reacting virus maker, viz, spleen, liver and lymphatic glands, equal parts, one or two inoculations, when tested on their immunity approximately 120 days later, were found susceptible.

The Assistant Chief Veterinary Research Officer carried out some experimental field vaccinations with extract in which the virus was attenuated and with a non-virulent extract and recorded experimental observations on the virus of rinderpest and the progress of prophylactic vaccination.

(b) East Coast Fever.

(1) The Assistant Chief Veterinary Research Officer spent his leave at the Moteno Institute, Cambridge, and studied whilst there, methods for investigating the life history of the parasite of East Coast Fever in particular and discussed tick parasites with Professor R. A. Cooley of Montana, U.S.A., who subsequently, at the invitation of Government, visited Kenya Colony.

During his leave the Assistant Chief Veterinary Research Officer arranged for the supply of preparations likely to be of value for the curative treatment of protozoal infections including East Coast Fever and Trypanosomiasis.

(2) *The function of the spleen in East Coast Fever.*—Dr. S. H. Whitworth when on leave, attended the post graduate pathological course at the Pathological Institute, University of Basle, and on his return in August, investigated the function of the spleen in East Coast Fever and whether splenectomy of naturally recovered animals would produce a breakdown to East Coast Fever or increase the susceptibility to re-infection.

A recurrence of protozoal infections, *e.g.*, redwater, anaplasmosis, theilera mutans, usually occurs in animals which have recovered from these infections, when deprived of their spleen. A recurrence of East Coast Fever did not occur in naturally recovered animals after splenectomy which would appear to indicate that the recovered animal is not a reservoir. Other observations on splenectomised animals are recorded by this officer.

(3) *Prophylactic vaccination with treated spleen pulp*, was carried out; the results obtained confirm those recorded by the writer in the Annual Report of the Chief Veterinary Research Officer for the year ended 31st December, 1927, *viz* :— that inoculation of treated spleen pulp is of no prophylactic value.

(c) Bovine Pleuro-Pneumonia.

Pleuro-pneumonia vaccine is largely used in this Colony. The preparation of a vaccine which produces a mild reaction and no mortality and confers immunity, presents difficulties

owing to the variations in susceptibilty of cattle. This difficulty has been overcome to some extent by the issue of a pure culture attentuated by sub-culture.

Unfortunately the vaccine subsequently becomes too attenuated by sub-culture and produces little or no reaction and a doubtful immunity and it is necessary to substitute a more virulent culture. This necessitates testing of each new lot of vaccine, prior to issue, on a large number of cattle to determine the virulency.

The preparation of a vaccine which produces no reaction but confers immunity was investigated, but the results obtained were not satisfactory.

(D) Redwater and Gallsickness.

Several head of laboratory-bred cattle, kept tick-free from birth, were inoculated with the existing strain of anaplasma centrale vaccine and with a new strain of redwater.

Provided the vaccine transmits redwater and anaplasma centrale when tested on susceptible cattle the advisability of reducing the period of detention of imported cattle at the Quarantine Station for redwater and gallsickness immunisation could be considered.

Testing the blood of redwater-gallsickness recovered animals furnished data on the pathogenicity of these infections in newly born calves. It was found that newly born calves reared under ranching conditons may safely be inoculated at birth or shortly after with blood of a naturally recovered beast.

Vaccination of dairy-reared calves.—It is doubtful whether, owing to their low resistance to disease, they would survive a reaction to the vaccine and the subsequent reaction to anaplasma marginale which they would contract from tick infection. The reaction to anaplasma centrale produced by the vaccine is, as a rule, mild and should confer a resistance against a severe reaction to anaplasma marginale. In any case this should be investigated.

(2) *The effect of tartar emetic on the viruses of redwater and gallsickness.*—Blood containing both infections after treatment for 30 minutes with tartar emetic was found to be still virulent for redwater and gallsickness.

(E) Heartwater.

Heartwater is more prevalent than generally recognised. The diagnosis of the disease is now made by microscopical examination of sections of kidney, brain and spleen.

The percentage of mortality which occurs when susceptible cattle are moved to an infected area was investigated and found to amount to approximately twenty per cent.

A bulletin on heartwater was written up and printed for circulation.

(f) Anthrax.

The spore vaccine was prepared during the year and will be substituted for the existing pasteurian vaccine if after experimental field tests it is found to give satisfactory results.

(g) Blackquarter.

With the exception of one or two instances when the vaccine is reported not to have protected some of the vaccinated cattle, the liquid vaccine has given satisfactory results in the practice. In those instances where protection is said not to have been conferred, it has not been possible to exclude infections due to other anaerobes for the want of material.

(h) Contagious Abortion and Sterility.

(1) *Cattle.*—Contagious abortion appears to be widespread and during the year a brochure on the prevention and control of the disease was printed for circulation amongst stockowners.

Questionaire sheets on sterility were circulated but so far replies received have been few; whilst in the majority of cases ovarian or uterine lesions are found in sterile cattle. In some instances bulls showed lesions of the genitalia which would explain the cause of sterility in some herds. In other cases the cause of sterility in bulls could only be explained as the result of a mineral or vitamin deficiency.

(2) *Horses.*—An outbreak of contagious abortion in mares was investigated.

(i) Horse-Sickness.

The preparation of horse-sickness serum was continued. Several horses belonging to private owners were immunised. The preparation of horse-sickness serum is being continued, there being a possibility of an increased demand for immunisation.

(j) Laikipia Lung Disease of Sheep.

Investigations were continued and methods of natural infection and other observations in connection with this disease made.

(K) Diseases of the Goat.

(1) *Contagious Pleuro-pneumonia.*—Contagious pleuro-pneumonia of the goat was investigated. The nature of the virus, experimental transmission of the disease and other data has been obtained.

(2) *Takosis.*—A condition analogous to that described in America apparently exists in Kenya Colony and further investigations are being carried out.

(L) Plant Poisoning.

Plant poison investigations were continued and valuable data has been obtained hereon.

(M) Avian Diptheria (Fowl Pox).

Supplies of the powder vaccine have been prepared and issued during the year. The disease is fairly prevalent and satisfactory results have followed its use, but precautions should be taken to vaccinate the flock before the disease appears.

AGRICULTURAL CHEMISTRY.

The staff of the chemical section was up to strength for practically the whole year.

There has been a great increase in the amount of work performed by the section. The equipment of the laboratories was practically completed, which allowed of the undertaking of work which before could not be performed.

Correspondence amounting to 773 inward and 460 outward letters was dealt with, many of these being of an advisory nature, and 608 reports were issued. 1,142 samples were received.

Travelling.—The staff travelled 777 miles in connection with experimental work.

Some improvement in the maintenance of the strength of cattle dip washes can be recorded. Over 33 per cent., however, of the samples received were dangerously incorrect. When the importance of dipping is considered, the results can by no means be considered satisfactory.

A preliminary soil survey of the Colony has been commenced by Mr. Gracie, the Assistant Agricultural Chemist. This has involved the taking of over 400 samples of soil and each such sample involves a considerable amount of laboratory work. Nevertheless, a preliminary report will be issued in bulletin form early in 1929. In the course of this work, four meetings were attended and three lectures delivered.

A comprehensive manurial experiment at the Scott Agricutlural Laboratories was destroyed by wash occurring as the result of an abnormally heavy fall of rain.

An experiment in which Seychelles Guano was used was laid down by the Assistant Agricultural Chemist and the Assistant Agricultural Officer at the Scott Laboratories. This escaped damage and was most successful. This has been fully reported in Bulletin No. 27 of 1928.

The subject of the possibility of the production of power alcohol from sisal waste was investigated during the year. It was found that there was no possibility of this being done profitably.

The analyses of coffee cherry referred to in the Annual Report for 1928 has been continued, while soil samples are in course of examination in the same connection.

The manurial experiments with coffee at Kassarini have been continued, but owing to drought little crop was produced and the bushes have now been heavily pruned. The fact has been demonstrated, however, that during a drought if a crop of cherry is produced the coffee suffers at the expense of the pulp. As little as 4 per cent. of clean coffee was yielded in several cases on treatment of cherry.

The work on coffee fermentation reported last year has been held in abeyance pending the arrival of the essential apparatus. This work will be continued in 1929.

A co-operative experiment was laid down in the Lower Molo District in conjunction with the Plant Breeding Section and headquarters staff; this was fully reported on in the Press.

Advice as to the manner of conducting farmers' experiments has been given by this section and by the headquarters staff, and assistance has been given with the rotation experiments at the Scott Agricultural Laboratories and Njoro.

Spray solutions were prepared for the Locust Campaign and a failure of the spray due to the source of the water supply was investigated.

ENTOMOLOGY.

The Entomologist was on leave from the 14th of May until the end of the year, Mr. Wilkinson acting in his absence. Mr. Kirkpatrick terminated his appointment of Assistant Entomologist on the 4th July to take a post with the Sudan Government.

Correspondence increased during the year and 1,883 letters were dealt with.

Travelling by the officers of the section amounted to 10,536 miles and 470 nights were spent away from the Laboratory.

Over 400 specimens have been examined exclusive of the definite investigations to which reference occurs below.

Six meetings were attended in conjunction with the Coffee Officer and meetings of the Coffee Planters' Union, and a general meeting at Nakuru on the subject of the maize stalk borer.

The outstanding features of the year have been the campaign again the locust (*Schistocerca gregaria*) and the clean-up in connection with the discovery of *Stephanoderes hampei* in several of the coffee-growing districts.

Stephanoderes appears to have a wide distribution in the Colony, although from several areas it has not been recorded. Fortunately, the damage done by this beetle has been confined to dry berries on the bushes, on the ground under the bushes, and to stored dry berries. The campaign organised by the Senior Coffee Officer had for its primary object the cleaning up of all fallen berries, the stripping of all dry berries from the bushes and the restriction of the movement of infested buni and its treatment. From the reports of the Inspectors and from material sent in by them it has been possible to map the distribution.

From material received it was found that the larvae of a Cerambycid beetle, a species of *Sophronica*, were also boring in dry beans and feeding on the beans.

With experience it is possible to distinguish the damage done by any of the berry borers, even in the absence of the actual insect.

Investigations into, and observations on, the life history and habits of locusts were carried out in so far as resources allowed in conjunction with the Locust Destruction Campaign. Considerable difficulty was experienced in laboratory invetigations since the development of the insects in captivity does not proceed on parallel lines with that of locusts under natural swarm conditions.

Dr. James was, for practically the whole year, engaged in an investigation into the control of stem borers of coffee. At the same time he did considerable work on the more important scale insects affecting coffee. These investigations are still incomplete and although a progress report has been issued, the results will be published later in the form of a bulletin.

Stem borers in coffee are more or less restricted to the lower altitudes where coffee is grown.

Leaf-eating caterpillars on coffee have again been reported. These seem to be more or less restricted to certain areas and are controlled by the timely application of arsenate of lead spray.

The coffee mealy bug still continues to be the worst pest in those areas in which it occurs. Further work is being undertaken to determine if any of the ant repellents, supplied by

different makers, are better than Cresoto, and an attempt will be made to increase the numbers of predaceous ladybirds by breeding these and distributing them where most necessary. The Cresoto bands properly applied and maintained have been successful and in several instances where complaints have been received it has been the fault of the application and not of the material.

During the last maize season stalk borer was not much in evidence and the benefits derived from the clean-up campaign of the season before are amply demonstrated.

MYCOLOGY.

The Mycologist was on duty throughout the year. Correspondence again increased and some 1,300 letters were dealt with. Enquiries on the subject of disease covered a range of no less than 27 hosts.

About 4,600 miles were covered on Government service; much of this travelling was undertaken in connection with the campaign to eradicate varieties of sugar cane suspectible to mosaic disease in the area where it exists.

Investigational work was very largely concentrated on problems connected with wheat stem rust and valuable results were obtained. The fact has been established that at least two different physiologic forms of stem rust exist in Kenya, and it has also been shown that these do not necessarily occur in the same districts in successive years. The work of testing by laboratory methods, the degree of resistance shown by the more important of the Plant Breeder's hybrid selections has been inaugurated and considerable progress in this direction has already been made.

Three distinct types of leaf injury of sisal have also received attention during the year. In each case the conclusion was reached that the trouble was non-parasitic and much evidence as to the actual causes of the various types of injury was obtained.

Leaf and berry fall of coffee in the cool season and a disease of barley were also the subjects of investigation.

The system of growing all importations of sugar cane in quarantine at the Scott Agricultural Laboratories until passed as free from disease, was instituted during the year.

No new disease of major importance, with the possible exception of the barley disease already mentioned, was recorded in 1928. Coffee berry disease, however, was found to exist in two new areas, namely Upper Songhor and Nandi Escarpment.

A new parasitic weed, a species of *Alectra*, was reported as causing 20 per cent. loss in certain leguminous crops in the Emberre Native Reserve. This species is closely related to the well-known striga weed, which, however, attacks members of the grass family only.

PLANT BREEDING.

The staff of the Plant Breeding Section consisted of the Plant Breeder and Assistant Plant Breeder, an Assistant Agricultural Officer and a part-time Laboratory Assistant. The first three were stationed at the new Njoro Plant Breeding Station, and the last at the Plant Breeding Station at the Scott Agricultural Laboratories.

A considerable amount of travelling was done by the Plant Breeding staff and addresses on cereals and cereal-growing were given by the Plant Breeder to farmers' meetings at Nanyuki, Thomson's Falls, Molo, Burnt Forest, Eldoret, Kitale, and Njoro.

During the tours of inspection of wheat and maize crops and of various experiments, the opportunity was taken by the Plant Breeder of assisting the Assistant Agricultural Chemist to make a preliminary soil survey of many of the settled areas. This survey was undertaken primarily to ascertain the causes of the poor and uneconomic yields of wheat and sometimes of maize not infrequently obtained on many soils. The results of the survey have been of great value, and a preliminary report will be published before the sowing season of 1929. If farmers carry out the advice, considerable increases in yields of cereal crops may be expected. Remarkable increases in yield were obtained during 1928 by applying only phosphatic fertilisers to previously infertile soils.

The Plant Breeding Station at Njoro was in full operation this year and some twenty acres of land were put under experiments. In addition to the usual wheat-breeding experiments, maize-breeding was also undertaken this year on a large scale and rotation and fertiliser experiments were also laid down. A full report on the activities at this station and at the sub-stations at the Scott Agricultural Laboratories and at Mau Summit will be found in Appendix " H " of this Report.

New crosses between wheats of hybrid origin were made this year at Njoro and the Scott Agricultural Laboratories, and from these it is expected to obtain excellent results. The problem of choosing suitable parents has been greatly simplified by the inoculation experiments of the Mycologist, who, by means of these, is able to determine the physiologic resistance of the new wheats to all the physiologic forms of stem rust he has isolated so far. As these experiments proceed it may be found advisable to alter some of the parents.

A number of new varieties of wheat bred by the Plant Breeder were tested out on the Plateau on Sir Neville Pearson's farm, and in the Trans Nzoia on Mr. Barbour's farm, and useful information was obtained. A few were also tried at Kilima Kiu Estates, Ulu.

Maize-breeding at Njoro has consisted of selection in the field from breeding plots, and also of ear-to-row tests. An interesting report on these latter appears in the Plant Breeder's report.

The fertiliser experiments at Njoro show the value of phospatic fertilisers and particularly superphosphate for wheat on soils like that found on the Plant Breeding Station.

Attention is also drawn to the comparatively high yields of maize obtained at the Njoro Plant Breeding Station. The high yields of maize which are obtainable in the maize belts are not expected in this particular part of Njoro, as the climate is rather cold for maize. Furthermore, the soil is not highly fertile and a bad season was experienced this year. Nevertheless, yields of eleven bags to the acre and over were obtained. Although the seed was well bred it is considered that this unexpectedly high yield was due more to the good and even stand obtained than to any other factor. The cobs were all small, but their number was sufficient to secure a good yield, and farmers are advised to pay considerable attention to the matter of good even stands and spacing of rows.

Some eighty farmers paid a visit in November to the Plant Breeding Station at Njoro, where a lecture was given by the Plant Breeder, and the visitors were shown round the experimental station. In this way a good opportunity is afforded of demonstrating the value of the work carried out.

The situation as regards growing wheat at the higher altitudes, such as Molo, Mau Summit, Timboroa, Upper Gilgil and Thomson's Falls, has become somewhat serious. The attack of " stem " rust in these districts was very much more severe than last year. Yields were reduced all round and in some cases crops were completely destroyed. In spite of its immunity to " yellow " rust, " Equator " can no longer be regarded as a safe crop to grow even at high altitudes, as " stem " rust, to which it is susceptible, is apparently becoming an increasing danger in those parts. " Kenya Governor " is unsuitable on account of its susceptibility to yellow rust. Until new rust-resistant wheats are issued in bulk, it will be advisable for farmers at high altitudes to grow such crops as barley, rye, oats or linseed, and perhaps the durum wheat known as " Golden Ball ".

New wheats are now in course of being issued, and precautions are being taken to prevent the price of seed rising too high, and to ensure that all farmers who require seed

can obtain it in equitable quantities as soon as sufficient is available. The new wheat known as B. 286 is already in the hands of several farmers, and it is hoped, in spite of depredations by locusts early in 1929, that there will be some 12,000 bags of seed available for distribution by March, 1930. This wheat is more resistant to " stem " rust than " Kenya Governor " and has short strong straw and tight chaff. Although its actual yielding capacity is rather lower than that of " Kenya Governor," the good qualities mentioned are likely to enable it to give higher average yield over a period of years than " Kenya Governor." Its milling quality is open to suspicion, but this will be tested in 1929. Whilst more resistant to " yellow " rust than " Kenya Governor ", it may not be sufficiently so as to allow it to be grown at high altitudes.

Some ninety new varieties of wheat produced by the breeding at Njoro will be issued in 1929 in quantities varying from a few ounces to 50 lb. of each. It is expected that some of these may be lumped together into a fewer number of varieties after further tests have been made with them in 1929. These wheats have so far proved themselves highly resistant either to " stem " rust only or to both " stem " rust and " yellow " rust, and these latter should prove useful at high altitudes. They appear capable of giving higher yields than Equator, Marquis or Kenya Governor, and have strong straw and tight chaff. The milling quality of a number of them appears doubtful, but more information in this connection should be obtainable in 1929.

It may be recorded that one large field of Kenya Governor was destroyed by " stem " rust this year owing to the advent of a physiologic form to which it is known to be susceptible.

Average yields of wheat have again been low, due in some cases to drought, coupled with somewhat infertile soils, and in other cases to rust.

Whilst maize yields in the Nakuru area were very seriously reduced by drought, it was thought that the yields would be up to average in the Trans Nzoia. These expectations were not realised owing to shortage of rains in July and August during the flowering period, a situation which was aggravated by the appearance of a disease called " White Blight ", which reduced further the yields of all varieties of maize except Natal White Horsetooth. As Natal White Horsetooth is not considered to be a particularly high yielding variety of maize, the Plant Breeder is investigating the problem of breeding a resistant variety.

SENIOR COFFEE OFFICER.

The Senior Coffee Officer was away on duty for 150 days, and travelled 5,950 miles.

401 interviews in his office and over 1,100 letters were dealt with, and ten notices were served under the Diseases of Plants Prevention Ordinance.

The bulletin " The Coffee Industry of Kenya Colony " was revised and brought up to date, and a leaflet on " Artificial Shade " was published.

The area of coffee in the bearing stage is recorded as being 60,575 acres in 1928, an increase of 7,724 acres over last year's return. The estimate of the 1927-28 crop was 213,043 cwt., the actual crop harvested being 246,292 cwt., including 32,621 cwt. of buni. The production has not increased in proportion to the increase in bearing acreage, but this is attributable to the effect of the droughty conditions prevailing during 1927. During the year ending 31st July, 1928, 259,689 cwt. of coffee were exported, valued at £1,415,537, representing 49.8 per cent. of the value of the total agricultural exports of the Colony.

Measures for the control of Stephanoderes (the coffee bean borer) were proposed and approved subsequent to the confirmation of its occurrence by the Entomologist in early April. At present the loss caused by the pest has not been great, but it is considered to be a source of great potential danger, hence the stringent measures for its control.

During the period under review, 416 visits to coffee plantations have been made, the Senior Coffee Officer having been assisted by the Assistant Grader and Inspector who came up from the Coast during the month of July, and by an Assistant Agricultural Officer who was drafted to the Coffee Section at the end of August.

Liberica and Robusta are reported by the Assistant Agricultural Officer to be suited to the conditions at the Coast, and requests have been made for a further supply of plants.

Three meetings of the Coffee Consulting Committee were held during the year, at which subjects of immediate interest to the industry were discussed.

In connection with the resolution passed by the Coffee Consulting Committee for a Coffee Experimental Station, it may be mentioned that in past years the necessity of procuring suitable land for establishing a well-equipped coffee station to elucidate the problems affecting the industry has been advocated, and in fact preliminary enquiries were made with that object in view, but the cost not only of acquiring the land but the maintenance of such a station was seen to be so great that neither at that time nor subsequently could the necessary funds be made available. In these circumstances and pending the

provision of a considerable grant for such a station, experimental work is being extended at the Scott Agricultural Laboratories as opportunity offers.

Other subjects discussed with the Coffee Planters' Union and the Coffee Consulting Committee included :—

1. The storage and cleaning of foreign coffee at the Coast; and permits have been issued under suitable safeguards for such storage and treatment to take place.

2. The measures proposed for the control of Stephanoderes.

3. The movement of coffee plants in connection with the spread of mealy bug, in consequence of which the Donyo Sabuk District was gazetted as a " guard " area.

4. Milling in transit rates on the Railway.

5. The necessity for legislation governing the sale of fertilisers and pest remedies; and several other questions of lesser importance.

Throughout the period under review the closest touch has been mantained with representatives of the industry and the output of work by the Coffee Section has been made possible only by the co-operation of those engaged in the industry.

The work of breeding up hardy strains of coffee is being continued at the Scott Agricultural Laboratories, and a further new selection for propagation has been made during the year.

Considerable attention has also been paid to the question of shade for coffee, both natural and artificial.

GRADING AND INSPECTION.

Plant Import Inspection.

Over 13,000 packages of fruit seed and plants imported into the Colony were inspected during the year, of a value of Sh. 514,975/16, and 102 packages, valued at Sh. 1,877/70, were passed in transit to Uganda.

Maize Grading and Conditioning.

465,853 bags of maize were inspected during the year, a decrease of 51 per cent. from the previous year. The percentage of native-grown maize is estimated at 1.6 per cent. of this total.

Bulk Shipment.

214,194 bags of K.2 maize were shipped in bulk to European ports.

107,352 bags were shipped without certificate to ports in Arabia and East Africa.

1,628 bags were rebagged and 1,027 resewn by the Kenya and Uganda Railway at the owners' expense.

Conditioning Plant.

42,343 bags wet maize, 4,313 bags weevily maize, and 21,155 bags wet wheat were reconditioned in the plant during the year.

Wheat.

Wheat Inspection Rules were in force from 1st July until November, when "Grading of Wheat Rules" came into force. During the year 66,577 bags were graded, of which approximately 30 per cent. required conditioning. Alterations to the existing machinery of the conditioning plant were made to permit of wheat being treated, and the plant worked satisfactorily.

Potatoes.

44,440 cwt. of potatoes were graded during the year, a large proportion of which had to be re-sorted before certificates could be issued.

Beans.

5,074 bags of beans were graded at the request of shippers.

Cool Stores.

More use of the Cool Stores has been made during the year, and the following quantities of commodities were stored :

Fruit	lbs.	...	128,399
Fresh fish	lbs.	...	14,196
Cured fish	lbs.	...	50,230
Small meats	pieces	...	794
Butter	cases	...	2,484
,,	lbs.	...	479
Beef	quarters	...	212
Mutton and pork	carcases	...	143
Vegetables	lbs.	...	8,161
Eggs	dozen	...	109
Cheese	lbs.	...	949
Poultry		...	126
Bacon and ham	lbs.	...	266
Sundries	parcels	...	8

LOCUSTS.

In February, 1928, flying locusts (*Schistocerca gregaria*) invaded the Colony, many of which matured. Eggs were laid during April and May over large areas in the Rift Valley from Longonot to the Sudan Border. Hoppers hatched out in May, and a general campaign for their destruction was undertaken in and adjacent to the settled areas by occupiers of land and

officers of the Department in conjunction with the Administration and temporary Locust Officers. The Locust Rules were published, and poison and spraying appliances were distributed for use in infested areas. The chief areas affected were from Elmenteita to Naivasha, Kerio and the Northern Frontier Provinces. Though the destruction of hoppers was almost complete in the settled areas, and numbers were destroyed in Kerio, many matured in the less accessible areas and flying swarms were again present in the settled areas in August. Damage to crops was wrought by these swarms in the Subukia, Ravine, Lower Molo, and Trans Nzoia Districts.

These swarms together with others from Galla country, Abyssinia and the Northern Frontier Province concentrated about Meru and Isiolo, Marsabit, Lake Rudolph, and the Rift Valley, generally from Njemps to the Sudan Border. Laying took place in these districts, in Kitui, Tanaland, the Coast, Machakos, Voi, and a little in the Masai Reserve, the area of probable infestation being estimated at 160,000 square miles. The eggs hatched at the end of November and during December.

These hatchings had been anticipated and preparations made on a large scale to deal with the resulting hoppers. Locust officers had been appointed in October to observe and scout. Meanwhile temporary locust officers had been engaged and were undergoing training; spray pumps mounted on lorries with tanks had been prepared, and in November completely equipped sections of locust officers, tank and transport trucks, and native assistants were sent out to attack the main concentrations. By the end of the year operations were being carried out against hoppers by the Administration, assisted by these sections, in almost every area in the Colony, with the exception of the settled areas and the Nyanza Province. Steps were also taken to organise the settled areas in a system of groups to co-ordinate individual effort. This campaign extended until the end of February, 1929.

The total sum expended in 1928 on locust destruction was approximately £21,000. The total damage during that period probably does not exceed £25,000 in both native and non-native areas.

FISHERIES.

Two fishery surveys have been carried out, one of Lake Victoria and the other at the Coast.

The former was undertaken by Mr. Graham, whose services were kindly placed at the disposal of the Governments of this Colony and Uganda by the Ministry of Agriculture and Fisheries, London. The main question is one of protection and preservation of those species of fish which are marketable.

To that end steps are being taken to regulate and control the fishing nets used. Other recommendations regarding the collection of statistics, the issue of licences, and the establishment of a " Fishing Authority " will receive further consideration.

The sea fishery survey along the coasts of Kenya and Zanzibar was carried out by Dr. C. von Bonde, whose services were made available through the kindness of the Government of the Union of South Africa. In his report, Dr. von Bonde summarises his general conclusions and recommendations as follows :—

" The following points strike me as the most important, and deserve the urgent attention of the Government if it is desired to foster the fishing industry and improve it along sound economic lines :

" The marine resources of Kenya are undoubtedly immense and valuable.

" The present methods of fishing should be revolutionised and developed along modern lines. Concurrently with this the methods of fish preservation should also be developed. I wish to repeat the suggestion that the Government should procure an experimental decked-in motor fishing boat, so as to establish a precedent which I am sure will speedily be followed. Such a boat would cost about £300 sterling, and should be used along the lines I have advocated above.

" A scientific investigation conducted by a fully equipped trawler into the potential trawling areas should be sponsored. I shall make the necessary enquiries as to the likely cost of such an experiment on my return to the Union of South Africa and shall submit a detailed statement to the Kenya Government.

" Enforcement of sanitary regulations in the various fish markets, so as to ensure the clean handling of fish for food purposes.

" Assistance to be rendered to fishermen in the construction of crawfish pots as previously described, so as to determine the magnitude of the supply of these crustaceans with a view to establishing canneries.

" Concurrently with the provision of a motor vessel, the potentialities of line fishing in the deeper waters, up to the 100-fathom line, should be investigated with a view to their exploitation.

" That for the present the number of fish traps be limited and no further additions to the present number be permitted."

LABOUR.

The average number of men, women and children (almost entirely Africans) employed on holdings in the European areas for the last five years are shown in the following table :—

Year	Men	Women	Children	Casual Daily Labour	Total
1928	83,000	4,654	17,295	9,271	114,320
1927	76,833	4,802	15,429	5,010	102,074
1926	74,873	6,021	13,717	Not enumerated	94,611
1925	61,735	5,477	11,315	same	78,527
1924	66,993	8,316	11,784	same	87,093

It will be noted that a steady increase is shown in the total since 1925. The reduction in the number of "women" workers is noteworthy. A plentiful supply of labour appears to have been available generally throughout the Colony. The findings of the Labour Commission, which reported early in 1927, appear, in the light of experience, to have been justified.

AGRICULTURAL SHOWS.

Reference to Native Agricultural Shows has already been made in the section dealing with Native Agriculture. Two agricultural shows were held under the auspices of the Agricultural and Horticultural Society of Kenya, one at Eldoret, and the other at Nairobi. Each attained a remarkable degree of success having regard to the unfavourable season. At the Eldoret Show, which embraced the Uasin Gishu and Trans Nzoia Districts in particular, there was an increase of 33 per cent. in the number of exhibits, and it was noteworthy in particular for the quality of the cereals, notably wheat, exhibited. The Nairobi Show, held under the distinguished patronage of H.R.H. the Prince of Wales and honoured by the presence of His Royal Highness and the Duke of Gloucester, was East African in character. The Governments of Uganda, Tanganyika, Zanzibar and Kenya participated, and each staged interesting exhibits representative of these Territories. This show was thoroughly representative of the agricultural industry of the Colony: notably the fourteen district exhibits displayed reflected the wide scope of agricultural production in the Colony. At both shows this Department staged an exhibit of educational value and illustrative of Departmental activities.

A grant-in-aid of £500 per annum to the Agricultural and Horticultural Society continues to be paid from the vote of this Department.

LAND SETTLEMENT.

As already stated the net increase in the number of occupiers of holdings is 70, and allowing for changes in occupation the total increase of new occupiers is 148. The apprehension which existed in 1925 and 1926 in regard to labour supply checked the increase, and the abnormally dry seasons since, coupled with the invasion of locusts in recent months, have not encouraged prospective settlers to take up land. Another factor has been the incidence of malaria in certain districts. Added to that the prices sought by land owners have not met with the views of prospective purchasers. The holding up of land for a large appreciation in value is not in the best interests of settlement and of the Colony. Nor is the position financially sound in many cases where the burden of interest on a mortgage bond or a bank overdraft cannot be carried by the returns from production from the comparatively small area of the holding which is beneficially occupied. Schemes for the promotion of land settlement have been devised and officers of this Department have devoted a great deal of time not only in their preparation but in the inspection of land for that purpose, likewise to the framing of the Land Bank Bill, upon which the settlement schemes are largely based.

For reasons stated above, the rising price of land has received a check, and land has not been readily negotiable, but there is no reason to suppose that with a return to normal and therefore more favourable conditions, land values will be restored to their former position. These temporary setbacks are not without advantage in a young Colony in the effect which they have upon the transfer of land to those who are in a position to make proper use of it.

LIBRARY AND PUBLICATIONS.

The opportunity is given to the public to make use of the library by obtaining issues of books and other literature on payment only of a deposit of Sh. 30. There are at present fifty-seven subscribers. With slender resources, a useful library, chiefly of works dealing with agriculture, economics, and science, is being built up, and it has proved most useful in providing information on many subjects on which information has been sought in connection with public affairs in the Colony.

The following reports, bulletins, etc., prepared by officers of the Department have been published during the year :—

" Annual Report of the Department of Agriculture for the year 1927."

" Agricultural Census, 8th Annual Report, 1927."

" Meteorological Records for the year 1927."

" Crop Report—September, October, November."

" Coffee Industry of Kenya Colony," by A. D. Le Poer Trench, O.A.C. (Dip. Ag.), Senior Coffee Officer. (Bulletin No. 19/1928).

" Diseases of Maize and Notes on a Parasitic Maize Weed in Kenya," by J. McDonald, D.F.C., B.Sc., F.L.S., Mycologist. (Bulletin No. 20/1928).

" Fungoid Diseases of Coffee in Kenya Colony," by J. McDonald, D.F.C., B.Sc., F.L.S., Mycologist. (Bulletin No. 21/1928).

" Progress Report on Insect Pests : White Borer of Coffee, Yellow Borer of Coffee, Fringed Scale of Coffee, Root Mealy Bug of Coffee," by H. C. James, B.Sc. (Edin.), Ph. D. (Vict.), N.D.D. (Glas.), N.D.A., Assistant Entomologist. (Bulletin No. 22/1928).

" Pasture Investigation in Kenya : Notes on the Effect of the Feeding of Mineral Salts to Grazing Animals," by H. Gunn, M.A., B.Sc., B.Sc. (Agric.), Rowett Research Institute. (Bulletin No. 23/1928).

" Pasture Investigation in Kenya : Notes on ' Nakuruitis ', by H. Gunn, M.A., B.Sc., B.Sc. (Agric.), Rowett Research Institute. (Bulletin No. 24/1928).

" The Coffee Berry Borer Beetle (*Stephanoderes hampei.* Ferr.)", by H. Wilkinson, A.R.C.Sc., F.E.S., F.L.S., Acting Entomologist.

Short Guides to the Activities of the Scott Agricultural Laboratories and the Plant Breeding Station at Njoro.

" Report of the Proceedings of the Fifth Maize Conference and First Wheat Conference, August, 1928."

" Regulations. Government Cool Stores, Kilindini."

" Grading of Wheat Rules, 1928."

" Grading of Maize Rules, 1925, and Maize Conditioning Plant, Kilindini." (Reprinted.)

" Heartwater (*R. ruminantium*)," by J. Walker, M.R.C.V.S., Chief Veterinary Research Officer. (Bulletin No. 25/1928.)

" The More Important Parasitic Worms in Sheep in Kenya," by R. Daubney, M.Sc., M.R.C.V.S., Assistant Chief Veterinary Research Officer. (Bulletin No. 26/1928).

" Prevention and Control of Contagious Abortion in Cattle : Enquiry Sheet into Sterility in Cattle," by R. W. M. Mettam, M.Sc., M.R.C.V.S., Veterinary Research Officer.

" Directions for the Use of Fowl Diptheria (Fowl Pox) Vaccine."

The following papers and articles were also published in other than Departmental publications :—

" Helminthic Infestations of Natives in the Kenya Highlands," by R. Daubney and J. A. Carmen. *Parasitology*, vol. xx., 13th July, 1928, pp. 185-206.

" Observations on Rinderpest," by R. Daubney, M.Sc., M.R.C.V.S. *Journal of Comparative Pathology and Therapeutics*, vol. li., parts 3 and 4.

" Recent Contributions to our Knowledge of Poisonous Plants in the Domestic Animals." *Veterinary Journal*, November, 1928, p. 562.

" Poisonous Plants and the Domestic Animals." *Kenya Medical Journal*, June, 1928.

" The Atrio-ventricular System of the Equine Heart." 13th and 14th Reports of the Director of Veterinary Education and Research, Pretoria, 1928.

" An Introduction to the Study of Poisonous Plants of Kenya," by R. W. M. Mettam, M.Sc.,M.R.C.V.S. Address to the Veterinary Medical Association of Kenya, January, 1928. Published in *Veterinary Record*, November 10th, 1928.

DEPARTMENTAL REPORTS.

Submitted with this report are included the following appendices :—

(*a*) Staff changes and new appointments in 1928.

(*b*) Staff at December 31st, 1928.

(*c*) Annual Report of the Chief Veterinary Officer.

(*d*) Annual Report of the Chief Veterinary Research Officer.

(*e*) Annual Report of Agricultural Chemist.

(*f*) Annual Report of Acting Entomologist.

(*g*) Annual Report of Mycologist.

(*h*) Annual Report of Plant Breeder.

(*i*) Annual Report of Senior Coffee Officer.

(*j*) Annual Report of Chief Grader and Inspector.

(*k*) Annual Report of Assistant Agricultural Officer, Scott Agricultural Laboratories.

(*l*) Annual Report of Assistant Agricultural Officer, South Kikuyu.

(*m*) Annual Report of Agricultural Officer, Nyanza, and Native Agricultural School, Bukura.

(*n*) Annual Report of Assistant Agricultural Officer, Coast.

(*o*) Annual Report of Assistant Agricultural Officer, Embu, Fort Hall and South Nyeri Districts.

(*p*) Annual Report of Assistant Agricultural Officer, Meru.

(*q*) Report of Locust Invasion, 1928, and action taken.

(*r*) Summary of Meteorological Records.

(*s*) Schedule showing Agricultural Exports for 1928, and previous years.

(*t*) Chart showing value of Agricultural Exports for 1928 and previous years.

ACKNOWLEDGMENTS.

During my absence on leave the duties of Acting Director devolved upon Mr. E. Harrison, Deputy Director, who discharged them with efficiency and he was ably supported at Headquarters by Mr. D. L. Blunt, Senior Agricultural Officer. To other members of the staff also I desire to express my appreciation of their loyalty, zeal and devotion to duty.

In the discharge of its many functions this Department relies upon those concerned with and engaged in the industry for co-operation and assistance. From Administrative Officers in the native areas must assistance has been received in the development of native agriculture. Such organised bodies as the Convention of Associations, Chambers of Commerce, the Coffee Planters' Union, the Sisal Growers' Association, the Kenya Farmers' Association, and the Agricultural and Horticultural Society of Kenya have worked with the Department in cordial co-operation, while such close contact as circumstances permitted has also been maintained with local associations.

To those delegates who have attended the various Conferences, and to Members of Consulting Committees appointed to deal with the coffee, maize, wheat and stock industries I am indebted for a full measure of support and much valuable service. The Department is similarly indebted to the Railways and Harbours Administration, likewise to colleagues in other Departments and non-official members of Legislative Council, who have served on Select Committees in connection with agricultural legislation.

ALEX HOLM,
Director of Agriculture.

Nairobi,
April, 1929.

APPENDIX A.

The principal changes and new appointments during the year under review were :—

1.—Administrative and General.

Mr. Alex. Holm, C.B.E., F.H.A.S., M.R.A.S.E., S.E.A.C. (Dip. Hons.), Director of Agriculture, returned from leave on 20th May.

Mr. E. Harrison, M.S.A., B.Sc. (Agric.), N.D.A., N.D.D., Deputy Director of Agriculture, was Acting Director of Agriculture for the period 1st January to 20th May.

Mr. F. B. L. Butler, F.L.S., Grader and Inspector, appointed Acting Chief Grader and Inspector, 24th November.

Mr. H. Wilkinson, A.R.C.Sc., F.E.S., F.L.S., Assistant Entomologist, appointed Acting Entomologist, 7th May.

Mr. F. W. Evans, Learner, appointed Junior Laboratory Assistant, 1st January.

Mr. B. F. Ratcliffe, Assistant Grader and Inspector, left the Service, 31st March.

Mr. B. A. Pickering, Laboratory Learner, appointed Junior Laboratory Assistant, 1st January.

Mr. T. W. Kirkpatrick, M.A., F.E.S., Assistant Entomologist, left the Colony on transfer to the Sudan Government, 28th March.

Miss M. E. Hall, Clerical Learner, left the Service, 30th April.

Mr. J. E. Dent, Clerical Learner, transferred to the Statistical Department, 30th April.

Mr. D. P. Herne, Junior Clerk, left the Service, 1st April.

Dr. H. C. James, Ph.D., B.Sc., N.D.A., N.D.D., Assistant Entomologist, arrived on first appointment, 2nd January.

Mr. W. O. Sunman, B.Sc. (Agric.), Assistant Agricultural Officer, arrived on first appointment, 17th February.

Mr. A. S. M. Gilfillan, Laboratory Learner, appointed locally, 5th March.

Mr. C. B. C. Handley, B.Sc. (Agric.), Assistant Agricultural Officer, arrived on first appointment, 17th March.

Mr. S. Gillett, S.E.A.C. (Dip. Agric. and Vety. Sc.), Assistant Agricultural Officer, arrived on first appointment, 12th May.

Mr. A. Clough, Junior Clerk, appointed locally, 1st May.

Mr. J. S. Nelson, Clerk, appointed locally, 2nd May.

Miss O. A. Kirkpatrick, Junior Clerk, appointed locally, 1st July.

Mr. W. D. D. Jardine, B.Sc. (Agric.), N.D.D., Live Stock Officer, appointed, 18th October.

Mr. C. L. Silvester, N.D.A., N.D.D., Temporary Assistant Grader and Inspector, appointed locally, 1st October.

Mr. O. J. Clark, Temporary Assistant Grader and Inspector, appointed locally, 11th December.

2.—Veterinary—Administrative and Executive Division.

Lieut.-Col. A. G. Doherty, M.C., M.R.C.V.S., Chief Veterinary Officer, was on duty from the 5th July until the end of the year.

Major H. H. Brassey Edwards, M.R.C.V.S., Deputy Chief Veterinary Officer, was Acting Chief Veterinary Officer for the period 1st January to 4th July.

Captain O. Dixon, M.C., M.R.C.V.S., Senior Veterinary Officer, carried out the duties of Acting Deputy Chief Veterinary Officer for the periods 1st January to 4th July and 1st September to 31st December.

Captain J. T. C. Bradshaw, Senior Veterinary Officer, was on duty in the Headquarters Office during the period 1st January to 24th May, 1928.

Captain E. J. Mulligan, Veterinary Officer, was detailed for duty at Headquarters Office from the 15th July, 1928, until the end of the year.

Mr. E. Beaumont, Veterinary Officer, was in charge of the Veterinary Quarantine Station, Nairobi, throughout the year in addition to his duties as District Veterinary Officer.

Mr. D. F. Macpherson, Veterinary Officer, and Stock Inspector Cassidy were detailed for duty at the Veterinary Quarantine Station, Nairobi, with effect from the 12th and 9th November, 1928, respectively.

The following Veterinary Officers arrived on first appointment during the year :—

Mr. T. B. McClure, on 17th March ; Mr. H. Hay-Barclay, on 31st August ; Mr. D. F. Macpherson, on 11th November ; Mr. W. M. McKay, on 24th November ; Mr. F. W. Aston, on 6th December.

The following Temporary Stock Inspectors were appointed locally during the year :—

Mr. F. J. O'Hara, on 28th May ; Mr. J. Anderson, on 1st June ; Mr. J. P. Cassidy, on 1st June ; Mr. A. H. Fitzgerald, on 1st July ; Mr. A. D. T. Montagu, on 9th July ; Mr.

A. R. Paxton, on 9th July; Mr. G. L. Murray, on 12th July; Mr. J. B. Levis, on 1st September; Mr. C. M. Watson, on 1st December.

The appointments of the following officers were terminated during the year :—

Mr. E. A. Wilshaw, Veterinary Officer, on 7th February; Mr. A. M. Brauen, Stock Inspector, on 27th January; Mr. J. Mackay, Stock Inspector, on 13th August; Mr. G. B. P. Curry, Stock Inspector, on 20th September; Mr. J. J. Scally, Stock Inspector, on 30th November; Mr. B. Stabin, Stock Inspector, on 31st December; Mr. A. H. Hayward, Temporary Stock Inspector, on 31st December.

The following officers of the Field Staff were attached to the Veterinary Research Laboratory, Kabete, at various periods during the year :—

Mr. T. B. McClure, Veterinary Officer; Mr. H. Hay-Barclay, Veterinary Officer; Mr. D. F. Macpherson, Veterinary Officer; Mr. W. M. McKay, Veterinary Officer, Mr. F. W. Aston, Veterinary Officer.

3.—Division of Veterinary Research.

Mr. J. R. Hudson, B.Sc., M.R.C.V.S., Veterinary Officer, was appointed Veterinary Research Officer, 30th September.

Mr. J. R. Kennedy, Clerk, was transferred from Land Department, 22nd February.

Mr. J. W. Shearman, Clerk, was transferred to Medical Department, 22nd October.

Mr. G. M. Smith, Clerk, was appointed locally, 23rd October.

Mr. A. E. Dawes, Temporary Clerk, was appointed locally 15th September, and transferred to Public Works Department, 31st December.

Mr. W. F. Gaunt, Temporary Relief Mechanic, appointed locally, 4th February to 31st October.

APPENDIX B.

STAFF LIST OF DEPARTMENT OF AGRICULTURE.

(As at 31st December, 1928.)

Director: Alex. Holm, C.B.E., F.H.A.S., M.R.A.S.E. (Gold Med.), S.E.A.C. (Dip. Hons.).

Deputy Director: E. Harrison, M.S.A., B.Sc., N.D.A., (Hons.), N.D.D.

Administrative and General.

Live Stock Officer: W. D. D. Jardine, B.Sc. (Agric.), N.D.D.

Statistical Officer: A. C. Hunter.

Accountant: H. S. Land.

Office Superintendent: E. J. Kelly.

Clerks: R. Abram, J. E. Harrison, J. R. Kennedy, L. Myers, J. S. Nelson, R. F. G. Palmer, F. Parker, J. Riddell, W. White, Mrs. M. A. Carr-Hole, Miss M. V. Ashe.

Junior Clerks: A. Clough, J. B. Gould, Miss O. A. Kirkpatrick.

Clerical Learners: Miss E. M. Geater.

Senior Coffee Officer: A. D. le Poer Trench, O.A.C. (Dip. Agric.).

Entomologist: T. J. Anderson, M.A., B.Sc. (Hons. Edin.), F.Z.S., F.E.S.

Assistant Entomologists: H. C. James, Ph.D., B.Sc., N.D.A., N.D.D.; H. Wilkinson, A.R.C.Sc., F.E.S., F.L.S.

Mycologist: J. McDonald, D.F.C., B.Sc. (Hons.), F.L.S.

Agricultural Chemist: V. A. Beckley, M.C., M.A., A.I.C.

Assistant Agricultural Chemist: D. S. Gracie, B.Sc. (Agric.), A.I.C.

Plant Breeder: G. J. L. Burton, M.C., B.A.

Assistant Plant Breeder: R. J. Lathbury, M.A.

Laboratory Assistants (Junior): F. W. Evans, R. N. Noble, B. A. Pickering.

Laboratory Assistant (Learner): A. S. M. Gilfillan.

Chief Grader and Inspector and Manager of Cool Stores: C. C. T. Sharp.

Grader and Inspector: F. B. L. Butler, F.L.S.

Assistant Graders and Inspectors: C. L. Silvester, N.D.A., N.D.D.; O. J. Clark (temporary).

Superintendent of Maize Conditioning Plant and Cool Stores : D. F. Sargent.

Mechanic : A. E. Taylor.

Senior Agricultural Officer : D. L. Blunt, M.A.

Agricultural Officers : A. G. Bailey, M.A.; P. Booth, N.D.A., U.D.A.

Assistant Agricultural Officers : R. C. Bentall, B.A. (Agric.); C. G. Bishop; S. Gillett, S.E.A.C. (Dip. Agric. and Vety. Sc.); C. B. C. Handley, B.Sc. (Agric.); A. S. Hartley; W. G. Leckie, B.Sc.; C. O. Oates, N.D.A.; N. D. Spranger; W. O. Sunman, B.Sc. (Agric.); H. J. Taylor, S.E.A.C. (Dip. Hons.); W. L. Watt, Cert. H.A.S., Forestry.

Veterinary.

1.—Administrative and Executive Division.

Chief Veterinary Officer : A. G. Doherty, M.C., M.R.C.V.S.

Deputy Chief Veterinary Officer : H. H. Brassey Edwards, M.R.C.V.S.

Senior Veterinary Officers : O. Dixon, M.C., M.R.C.V.S.; R. C. Wheeler, M.B.E., M.R.C.V.S.; J. T. C. Bradshaw, M.R.C.V.S.

Veterinary Officers : R. Scott Little, M.R.C.V.S., D.V.S.M.; R. L. Creery, M.R.C.V.S.; E. J. Mulligan, M.R.C.V.S.; W. G. Emerson, M.R.C.V.S.; F. R. Hale, M.R.C.V.S.; E. Beaumont, M.R.C.V.S.; W. Fotheringham, M.R.C.V.S.; W. B. C. Danks, B.Sc., M.R.C.V.S.; T. B. McClure, M.R.C.V.S.; H. A. Hay-Barclay, M.R.C.V.S.; D. F. Macpherson, M.R.C.V.S.; W. M. McKay, M.R.C.V.S.; F. W. Aston, M.R.C.V.S.

Stock Inspectors : D. Wyartt, R. A. C. Campbell, W. L. Lewis, G. White, H. E. Evans, L. E. Smith, H. Thorne, T. Harris, F. T. O'Meagher, J. F. A. Greig, C. B. Jolley, P. H. Poolman, C. P. Glover, J. Denwett, A. Lambie, J. H. Ward, A. H. Moeran, H. C. W. Guy, F. J. O'Hara.

Temporary Stock Inspectors : R. H. Cameron, J. Anderson, J. P. Cassidy, H. G. Fitzgerald, A. D. T. Montagu, A. R. Paxton, G. L. Murray, J. B. Levis, C. M. Watson.

2.—Division of Veterinary Research.

Chief Veterinary Research Officer : J. Walker, M.R.C.V.S.

Assistant Chief Veterinary Research Officer : R. Daubney, M.Sc. (Wash.), M.R.C.V.S.

Veterinary Research Officers : S. H. Whitworth, B.V.Sc. (Melb.), D.V. (Zur.), M.R.C.V.S.; R. W. M. Mettam, M.Sc., M.R.C.V.S.; J. R. Hudson, B.Sc., M.R.C.V.S.

Laboratory Superintendent : A. Walker.

Laboratory Assistants : J. T. Schultz, H. J. Gray, J. R. McQueen, E. J. Hall, W. P. Bruce, F. Lyons, J. Forsyth, S. R. Pelling.

Overseer : J. Burton.

Yard Foreman : A. McDougall.

Clerks : A. E. Johnstone, A. J. Kemp, J. H. Crampton, G. M. Smith.

Clerical Learner : Miss R. M. Dennis.

Mechanic : O. Stenmark.

Storekeeper : J. Scott.

Assistant Storekeeper : G. W. Clochley.

APPENDIX C.

REPORT OF THE CHIEF VETERINARY OFFICER.

Foreword.

In submitting this my last annual report I would like to thank all the officers of the Field Staff for their help and assistance in obtaining what success has been possible in dealing with the many diseases that affect domesticated animal life in Kenya.

In particular, I would mention the services of Major H. H. Brassey Edwards in connection with the work amongst native live stock, and Captain E. J. Mulligan, who has borne a considerable strain in shouldering a major share of the administration's work at headquarters since my failing health necessitated frequent and prolonged absences from office.

Part 1.—Administrative.

Distribution of Veterinary Staff as at 31st December, 1928.

Headquarters, Nairobi.

Lieut.-Col. A. G. Doherty, Chief Veterinary Officer.

Captain E. J. Mulligan, Veterinary Officer.

District Veterinary Staff, Nairobi.

District Veterinary Officer Beaumont (Nairobi District and Southern Kikuyu Reserve).

Veterinary Officer Macpherson (Veterinary Quarantine Station, Nairobi).

Stock Inspector Cassidy (Veterinary Quarantine Station, Nairobi).

Veterinary Training Depot, Ngong.

Acting Deputy Chief Veterinary Officer Dixon.

Stock Instructor Anderson.

Rinderpest Service—Mobile—Alienated Areas.

Veterinary Officer Hudson.
Veterinary Officer Fotheringham.
Veterinary Officer Hay-Barclay (for instruction).
Veterinary Officer McKay (for instruction).
Stock Inspector Wyartt.
Stock Inspector Glover.
Stock Inspector Denwett.
Stock Inspector Cameron.
Stock Inspector Montagu.
Stock Inspector Fitzgerald (for instruction).
Stock Inspector Watson (for instruction).

Machakos Area.

Veterinary Officer Scott-Little (Native Reserve).

Stock Inspector Greig (Native Reserve).

Nanyuki and Nyeri—Laikipia District.

District Veterinary Officer Danks (Alienated Areas and neighbouring Native Reserves).

Stock Inspector Poolman (Alienated Areas).

Stock Inspector Lewis (Veterinary Quarantine Station, Isiolo).

Naivasha and Nakuru Districts—Alienated Areas.

District Veterinary Officer Creery, Gilgil.

Stock Inspector Thorne, Nakuru.

Kisumu-Londiani and Molo Districts.

District Veterinary Officer Emerson (Alienated Areas and neighbouring Native Reserves).

Stock Inspector O'Meagher (Alienated Areas).

Stock Inspector Moeran (Native Reserves).

Stock Inspector White (Veterinary Quarantine Station, Kibigori).

Uasin Gishu and Trans Nzoia Districts.

Senior Veterinary Officer Wheeler (Alienated Areas and neighbouring Native Reserves).

Stock Inspector Harris (Alienated Areas), Eldoret.

Stock Inspector Jolley (Alienated Areas), Kitale.

Stock Inspector O'Hara (Native Reserve), Nandi.

Stock Inspector Murray (Veterinary Quarantine Station, Kitai, North Kavirondo Reserve).

Native Reserves.

Kamasia, Njemps, and Uasin Gishu Masai

Veterinary Inspector Hassan (Veterinary Quarantine Station, Timboroa).

Veterinary Assistant Abdul Ghani (Njemps Native Reserve).

Mombasa.

Veterinary Assistant Rahman (District and Port Duties).

Central Kavirondo Native Reserve.

Veterinary Officer McClure.

Stock Inspector Lambie.

Stock Inspector Paxton.

Stock Inspector Levis.

On Leave.

Deputy Chief Veterinary Officer.
Senior Veterinary Officer Bradshaw.
Veterinary Officer Hale.
Stock Inspector Smith.
Stock Inspector Campbell.
Stock Inspector Evans.
Stock Inspector Ward.
Stock Inspector Guy.

Four vacancies for Veterinary Officers were filled during the year 1928. Provision was originally made for the appointment of seven Veterinary Officers during the year, but of these appointments three only were filled. It is to be regretted that the four officers were not appointed until late in the year, as this adversely affected the amount of work estimated for the year to be carried out in the Native Reserves, with a consequent reduction of revenue.

Mr. J. R. Hudson, Veterinary Officer, was transferred from the Veterinary Division to the Veterinary Research Division, with effect from the 30th September, 1928, but remained in charge of the Rinderpest Service until the end of the year.

SUMMARY OF EXPENDITURE—1928.

VETERINARY DIVISION.

	Original Estimate Sanctioned	Actual Expenditure	Excess	Savings
	£	£	£	£
Personal Emoluments	30,778	25,313	..	5,465
Labour	4,804	4,661	..	143
Medicines and Instruments ..	700	612	..	88
Maintenance of Veterinary Stations	3,400	3,122	..	278
Maintenance of Dips	400	193	..	207
Hors Allowance	72	33	..	39
Purchase of Animals and Equipment	300	293	..	7
Compensation payable under Diseases of Animals Ordinance	150	462	312	..
Incidentals	1,030	665	..	365
Purchase of Brands	170	79	..	91
Passages	1,995	1,880	..	115
Travelling Allowances ..	1,730	1,075	..	655
Local Transport and Travelling	10,470	8,887	..	1,583
Carriage of Goods	900	704	..	196
Library Books and Periodicals	150	160	10	..
Upkeep, Travelling Laboratory	250	77	..	173
Expenses of Instruction ..	600	439	..	161
Typewriters	80	80	..	..
Microscopes	140	117	..	23
TOTAL VETERINARY DIVISION	58,119	48,852	322	9,589

COMPARATIVE STATEMENTS OF EXPENDITURE AND REVENUE FOR THE YEARS 1924 TO 1928 INCLUSIVE.

Veterinary Division.

	1924	1925	1926	1927	1928
	£	£	£	£	£
Expenditure (Actual) ..	29,546	37,026	38,627	41,890	48,852
Revenue (Actual) ..	11,536	24,520	25,320	22,400	16,877
Expenditure (After deducting Revenue) £	18,010	12,506	13,307	19,490	31,975

Veterinary Research Division.

	1924	1925	1926	1927	1928
	£	£	£	£	£
Expenditure (Actual) ..	20,600	27,743	29,686	29,888	30,332
Revenue (Actual) ..	7,328	6,543	4,712	5,174	10,830
Expenditure (After deducting Revenue) £	13,272	21,200	24,974	24,714	19,502

Total Expenditure, Veterinary Services, for the Years 1924 to 1928, after the Deduction of Revenue.

	£
1924	31,282
1925	33,706
1926	38,281
1927	44,024
1928	51,477
	£ 198,770

COMPARATIVE STATEMENT OF REVENUE FOR THE YEARS 1926, 1927 AND 1928.

Station	1926	1927	1928	Total 3 years
	Sh. cts.	*Sh. cts.*	*Sh. cts.*	*Sh. cts.*
Settled Areas.				
Nakuru	6,575 06	3,253 70	8,422 75	18,251 51
Naivasha	420 36	..	..	420 36
Nanyuki	34,206 10	62,466 18	1,515 15	98,187 43
Lumbwa	1,916 50	2,274 00	5,090 40	9,280 90
Eldoret	1,034 50	806 80	3,297 60	5,138 90
Nairobi	15,335 90	17,527 00	18,323 55	51,186 45
Kitale	328 00	530 00	146 00	1,004 00
Rumuruti	1,970 48	..	..	1,970 48
Rinderpest Service	60,264 50	60,478 50	135,602 00	256,345 00
Gilgil	..	1,193 45	11,278 45	12,471 90
Total *Sh.*	122,051 40	148,529 63	183,675 90	454,256 93

COMPARATIVE STATEMENT OF REVENUE FOR THE YEARS 1926, 1927 AND 1928.—(*contd*).

STATION	1926	1927	1928	Total 3 years.
QUARANTINE STATIONS AND NATIVE RESERVES.	*Sh. cts.*	*Sh. cts.*	*Sh. cts.*	*Sh. cts.*
Mombasa	16,046 96	23,254 60	19,217 50	58,519 06
Eldama Ravine ..	164 40	.. ..	..	164 40
Isiolo	9,083 31	980 50	7,254 00	17,317 81
Kibigori	27,910 50	9,529 00	11,718 00	49,257 50
Machakos	30,451 96	12,952 50	7,604 00	51,008 46
Waterfalls	39,288 00	11,166 50	..	50,454 50
Kitai and Bungoma	94,266 00	142,800 50	36,149 50	273,216 00
Kingwal	60,594 50	16,631 50	20,103 60	97,329 60
Timboroa	51,620 50	..	25,583 00	77,203 50
Ukamba (Rinderpest Service) ..	54,718 54	.. ..	..	54,718 54
Ngong	216 00	..	..	216 00
Sondu	..	6,781 00	4,235 50	11,016 50
Kaptumo	..	2,101 50	..	2,101 50
Kilungu, Mbooni & Sultan Hamud	..	46,526 50	..	46,526 50
Kamasia	..	15,391 00	1,421 00	16,812 00
Kakunga	..	5,117 00	..	5,117 00
Chebororwa ..	..	6,117 00	6,161 00	12,338 00
Kisumu	..	..	14,417 00	14,417 00
TOTAL .. *Sh.*	384,360 67	299,489 10	153,8 4 10	837,713 87
GRAND TOTAL *Sh.*	506,412 07	448,018 73	337,54) 00	1,291,970 80

REVENUE.

The total amount of revenue collected during the year 1928 was Sh. 337,540, which represents Sh. 110,460 less than the total collected during the previous year.

Of the total revenue of Sh. 337,540, the sum of Sh. 183,675/90 was derived from the settled areas, and Sh. 153,864/10 from native reserves and veterinary quarantine stations. These figures are an increase of Sh. 35,146/27 in respect of settled areas, and a decrease of Sh. 145,625 in respect of native areas, as compared with the revenue collected during 1927.

The revenue collected by the field staff of the Veterinary Division is in respect of fees for inoculations carried out with sera and vaccines prepared at the Veterinary Research Laboratory, Kabete, and fees derived from testing and quarantine stations.

It is to be observed that the decrease in revenue collected this year as compared with the previous year is a decrease mainly and entirely in revenue collected from native reserves.

This fact is to be accounted for by the continuance of drought conditions which prevailed throughout all the native reserves, and to unfilled vacancies amongst the directing staff.

Rinderpest Inoculations.

The appended tables show the total rinderpest inoculations in all areas during the year :—

Area	Double Inoculations	Virulent Blood Tests	Serum Alone Inocs.
Settled Areas.			
(*a*) *By District Staffs.*			
Nairobi	1,304	..	..
Gilgil	11 648	..	..
Lumbwa	1,596	..	..
	14,548	..	..
(*b*) *By Rinderpest Service in Settled Areas.*			
Nanyuki and Nyeri	8,038	130	..
Laikipia and Ngobit	9,720	18	..
Gilgil	2,061	890	..
Lumbwa District	12,296	2,488	..
Burnt Forest Area	9,025	245	..
Uasin Gishu and Trans Nzoia	41,497	11,475	..
	82,637	15,246	..
In Native Reserves and at Veterinary Stations			
Kamasia Reserve	126	29	..
Kingwal (Nandi)	9,065	1,464	..
Kitai (North Kavirondo)	16,391	54	68
Machakos (Ukamba)	3,004	15	..
Kibigori (Central Kavirondo)	3,887	106	..
Sondu (Lumbwa)	1,012	19	..
Nyakatch (South Kavirondo)	967	..	..
Njemps Reserve	4,973	4,739	..
Timboroa (Uasin Gishu, Masai)	4,495	1,010	..
Chebororwa (Marakwet)	798	3,258	5
Kisumu (Central Kavirondo)	12,556	63	..
Ngong (Masai)	379	..	..
Maseno (Central Kavirondo)	1,643	..	..
	59,296	10,757	73
Totals.			
In Settled Areas by District Staffs	14,548	..	..
In Settled Areas by Rinderpest Service ..	82,637	15,246	..
In Native Reserves and at Veterinary Quarantines	59,296	10,757	73
Grand Total ..	156,481	26,003	73

The total mortality from all causes was approximately 3,170.

For purposes of comparison the total figures of rinderpest inoculations for the year 1927 are appended :—

	Double Inoculations	Virulent Blood Tests	Serum Alone Inocs.	Mortality (Approx.)
In Settled Areas by District Staffs..	25,790	..	1,084	..
In Settled Areas by Rinderpest Service	27,917	500	..	..
In Native Reserves and at Veterinary Stations	102,853	3,176	10,655	..
TOTAL ..	156,560	3,676	11,739	3,734

PART 2.—SETTLED AREAS.

NAIROBI VETERINARY DISTRICT.

Includes the Limuru, Kyambu, Ruiru, Thika and Makuyu Settled Administrative Districts, and the Southern Kikuyu Native Reserve, all of which are endemic East Coast fever areas, with the exception of a comparatively small area known as the Limuru "clean area."

Summary of outbreaks of diseases in the Nairobi District during the years 1927 and 1928 :—

Disease.	*Number of outbreaks during* 1927.	1928.
Rinderpest	7	5
East Coast Fever	4	1
Horse Sickness	—	11
Ulcerative Lymphangitis ...	8	8
Epizootic Lymphangitis ...	—	4
Anthrax	7	9
Swine Fever	1	—

Rinderpest.—Two outbreaks occurred among European and squatter-owned cattle in the Thika District, two further outbreaks occurred amongst European-owned stock in the Kikuyu District, and one outbreak in the Eastleigh Township.

In all cases the disease was successfully prevented from spreading and three of the outbreaks were dealt with by double inoculation.

During the year a total of 1,304 head of cattle were double-inoculated by the District Staff, of which number 152 head were dipped stock.

East Coast Fever.—One outbreak of East Coast fever occurred within the Limuru "clean area." Two oxen died from this disease at the time of the outbreak, but no further cases have as yet been recorded. The source of this outbreak was untraced.

Anthrax.—Nine outbreaks of this disease have been confirmed microscopically, and 977 head of cattle were vaccinated with the double anthrax vaccine, without any unfavourable results.

Horse Sickness.—There was a marked increase of this disease over the preceeding year. Eleven cases in all were confirmed in the Nairobi District, and all the affected animals died. The majority of the cases occurred during the months of June and July. No cases were reported during the year 1927.

Veterinary Dispensary, Nairobi.—During the year the following animals received treatment at the Veterinary Dispensary :—

Equines, 85; Bovines, 24; Canines, 587; Felines, 46; total, 742.

A number of cases were brought to notice by the Inspector of the East African Society for the Prevention of Cruelty to Animals, and as a result sixteen animals were certified as unfit for work.

In addition to the above animals, cases of sickness or accidents have been treated in animals belonging to the Military Authorities, Kenya Police, Kenya and Uganda Railways, Government Transport, and the Nairobi Corporation.

A report of the work carried out at the Veterinary Quarantine Station, Nairobi, is dealt with later under a separate heading.

NANYUKI VETERINARY DISTRICT.

This area includes the North and South Nyeri and Laikipia Districts.

Summary of outbreaks of diseases in the Nanyuki District during the years 1927 and 1928 :—

Disease.	*No. of outbreaks during:* 1927.	1928.
Rinderpest	28 ...	4
East Coast Fever	21 ...	4
Blackquarter	11 ...	8
Bovine Pleuro-pneumonia ...	3 ...	2
Anthrax	4 ...	3
Foot and Mouth Disease ...	5 ...	3
Sheep Pox	1 ...	—
Horse Sickness	6 ...	3
Ulcerative Lymphangitis ...	4 ...	4
Epizootic Lymphangitis ...	2 ...	2
Canine Piroplasmosis ...	12 ...	11

The number of reported outbreaks of rinderpest during the year under review are considerably less than those reported during the previous year, the figures for which were 28 as against 4, and similar satisfactory progress has to be recorded regarding East Coast fever, *i.e.*, 4 outbreaks as against 21 in 1927.

Rinderpest.—It is regretted that the outbreaks of rinderpest, as in the previous year, are to be attributed to infection by game.

East Coast Fever.—In this district East Coast fever has little significance from the point of view of mortality, as practically all stock farms in the district have been equipped with cattle dips.

Compulsory dipping still remains in force in the Nanyuki Township and has been applied to the Rumuruti Township.

Compulsory dipping in townships serves a very useful purpose in endeavouring to eradicate East Coast fever, since Townships are mostly grazed by small herds of cattle owned by plot-holders collected from various parts of the country and subject to little supervision.

Bovine Pleuro-pneumonia.—Although in close proximity to the Northern Frontier Province, only one outbreak of pleuro-pneumonia occurred, resulting in one death from that disease. The origin of this outbreak is somewhat obscure.

The following inoculations were carried out by the district staff during the year : Pleuro-pneumonia, 746 ; anthrax, 94 ; blackquarter, 4,120.

Outbreaks of anthrax, blackquarter, trypanosomiasis, lymphangitis, sheep scab and horse sickness have been recorded, without serious mortality. Laikipia lung disease, however, has

been prevalent and a vaccine has been prepared by the Laboratory, and is being extensively used experimentally, with encouraging results.

GILGIL VETERINARY DISTRICT.

This area includes the Kijabe, Naivasha, Nakuru, Thomson's Falls, and Ravine Districts.

The following outbreaks of diseases were reported during the year 1928, and the numbers for 1927 are quoted for purposes of comparison :—

Disease.	*No. of outbreaks during:* 1927.	1928.
Rinderpest	18	11
Bovine Pleuro-pneumonia	7	3
East Coast Fever	16	9
Trypanosomiasis	3	1
Blackquarter	7	1
Anthrax	11	14
Foot and Mouth Disease	12	3
Horse Sickness	2	4
Ulcerative Lymphangitis	3	5
Epizootic Lymphangitis	2	1
Contagious Bovine Abortion	1	5
Swine Fever	1	4
Sheep Pox	1	—
Anaplasmosis	—	15
Heartwater	—	3
Redwater	—	3

The diseases redwater and anaplasmosis are prevalent throughout the district.

The district staff carried out the undermentioned inoculations during the year :—

Double inoculation against rinderpest	11,648
Pleuro-pneumonia vaccinations	5,302
Anthrax vaccinations	440

Rinderpest.—Although outbreaks of rinderpest were less than during the previous year, *i.e.*, 11 as compared with 18, the disease was, however, very prevalent in the Rift Valley, between the Kedong and Njoro, and again the original infection has been attributed to game from the Mau. It is noticeable in some instances that the disease was not of a virulent type, particularly in one case where a herd of grade Frieslands was affected without mortality and with the administration of only comparatively small doses of serum per head. Some of these outbreaks were dealt with by rinderpest blood kept at a low temperature—zero, Cent.

Virulent blood under this condition has not entirely been satisfactory, and requires further research work before it can be used generally in the field.

SUFFOLK RAMS IMPORTED FOR IMPROVEMENT OF NATIVE SHEEP.

"BLACKHEAD" PERSIAN SHEEP IMPORTED FROM SOUTH AFRICA FOR THE IMPROVEMENT OF NATIVE SHEEP.

East Coast Fever.—Outbreaks of East Coast fever numbered 9 as against 16 during the previous year. In the case of one outbreak particularly where a dip was not available, mortality to the extent of 75 per cent. was reported. It is considered that in this particular case infection existed on the farm for some considerable time before it was discovered.

This again points to the necessity of anticipating by preparation, *i.e.*, the availability of a dip, and careful inspection of all sick and dead animals on the farm.

Bovine Pleuro-pneumonia.—Three outbreaks of pleuro-pneumonia, as against seven during the previous year, were reported. In one instance the mortality was very severe, and the disease appeared first amongst squatters' cattle. It is probable that this disease also existed for a considerable time before notification and the consequent delay of sanitary control.

Anthrax.—During the year 14 outbreaks of this disease were recorded, without serious mortality. Immunisation was carried out.

Outbreaks of heartwater, anaplasmosis, lymphangitis, horse sickness and swine fever were also reported.

Uasin Gishu and Trans Nzoia Districts.

The following outbreaks of diseases were reported during the year, and the figures for the previous year are given for comparison :—

Disease.	*No. of outbreaks during:* 1927.	1928.
Rinderpest	20 ...	32
Bovine Pleuro-pneumonia ...	10 ...	3
Trypanosomiasis	3 ...	1
Anthrax	5 ...	17
Blackquarter	2 ...	8
Tuberculosis	1 ...	—
Bovine Lymphangitis ...	1 ...	—
Ulcerative Lymphangitis ...	25 ...	10
Epizootic Lymphangitis ...	3 ...	—
Swine Fever	— ...	3
Heartwater	— ...	1
Foot and Mouth Disease ...	— ...	1
Muthiuko (Turning Sickness)	— ...	5

Rinderpest.—The position regarding rinderpest has been very serious. Thirty-two outbreaks were recorded, which is a material increase on the twenty outbreaks during the previous year. Many of these outbreaks are again attributed to game infection, and the illicit movement of native-owned cattle from the native reserves.

The position became so serious that the Trans Nzoia District Committee passed and forwarded a resolution requesting the application to the district of regulations for compulsory double inoculations. These regulations were applied with very satisfactory results, and if carried out annually rinderpest will no longer be a menace to the cattle population of the district.

Bovine Pleuro-pneumonia.—The position is more satisfactory as regards pleuro-pneumonia. Only three outbreaks were recorded as compared with ten during the previous year.

Anthrax.—Anthrax is prevalent, 17 outbreaks having been recorded during the year.

East Coast Fever.—East Coast fever is endemic, and this disease continues to cause mortality.

The incidence of disease generally appears to be coincident with the large herds of stock owned by squatters on European farms and to the conspicuous absence of fencing and methodical dipping.

Tick-borne diseases continue to affect seriously the grade stock in these areas.

Other diseases such as heartwater, blackquarter, trypanosomiasis, lymphangitis, and swine fever have each been recorded.

Lumbwa Veterinary District.

This area includes the Kisumu-Londiani, Molo, Sotik and Kericho Districts.

The following outbreaks of diseases were reported during the year, and the numbers for 1927 are quoted for comparison :—

Disease.	*No. of outbreaks during:* 1927.	1928.
Rinderpest	1 ...	21
Bovine Pleuro-pneumonia ...	3 ...	—
East Coast Fever	3 ...	12
Blackquarter	2 ...	1
Ulcerative Lymphangitis ...	2 ...	—
Trypanosomiasis	5 ...	2
Foot and Mouth Disease ...	5 ...	—

The number of cattle double-inoculated against rinderpest by the district staff totalled 1,596 head, and 485 head were vaccinated against bovine pleuro-pneumonia.

Rinderpest.—In this district the position regarding rinderpest has been unsatisfactory. As many as 21 outbreaks have been recorded, as against one outbreak during the previous year. As in the case of other districts, game has played a large part in dissemination, but such dissemination is comparatively easy having regard to the large numbers of squatter stock permitted on European farms.

ANALYSIS OF INOCULATIONS AND VACCINATIONS CARRIED OUT BY VETERINARY FIELD STAFF, 1928

STATION	Rinderpest Double Inoculations						Rinderpest Virulent Blood Tests	Anti-Rinderpest Serum Alone Inoculations	Pleuro-pneumonia Vaccinations	Pleuro-pneumonia Tests	East Coast Fever Tests	Mallein Tests	Rinderpest Double Re-inoculations	Free Rinderpest Double Inoculations		Mortality. All Causes	Anthrax Vaccinations	Blackquarter Vaccinations
	Adults			Calves										Calves	V.B. Tests			
	Native Stock	Farm Stock	Trade Stock	Native Stock	Farm Stock	Trade Stock												
Molo River	126	..	..	..	..	..	29	..	609	..	..	..	..	..	..	4	..	..
Njemps Native Reserve	4,973	..	..	..	..	..	4,739	..	..	..	..	..	..	..	..	9	..	..
Timboroa Quarantine Station ..	4,495	..	..	..	..	..	1,010	..	2,120	..	..	..	..	..	..	33	..	..
Kitai Quarantine Stn.	13,462	16	19	2,894	..	..	54	68	849	..	..	..	..	..	..	320	..	..
Kingwal Quar. Stn.	8,720	181	164	..	..	..	1,464	..	654	..	..	..	..	..	..	230	29	..
Chebororwa Quarantine Station ..	758	40	..	..	..	..	3,258	5	4,103	..	..	..	..	..	..	42	..	..
Machakos Quar. Stn.	2,242	190	572	..	..	..	15	..	252	..	16	..	..	..	..	180	..	..
Kibigori Quarantine Station	3,140	733	Govt. 14	..	..	..	106	..	3,625	..	186	..	..	..	..	192	..	..
Sondu Quar. Station	1,012	..	..	..	..	..	19	..	20	..	..	..	..	..	..	66	..	..
Nyakatch Quar. Stn.	967	..	..	..	..	..	..	..	..	..	..	..	..	..	..	62	..	..
Samburu Native Reserve, N.F.P. ..	..	..	..	..	..	..	..	..	22,369	..	..	..	..	..	..	..	..	..
Rinderpest Service..	..	57,320	..	..	23,667	..	14,356	..	..	..	..	..	1,203	447	890	1·6% (1,525)	..	..
Nairobi	159	734	219	3	189	..	..	..	..	..	..	..	..	..	..	..	977	..
Gilgil	..	11,648	..	..	..	..	..	..	5,302	..	..	..	..	..	..	..	440	..
Nanyuki	..	..	..	..	..	..	..	..	746	..	..	..	..	..	..	..	94	4,120
Isiolo	..	..	..	..	..	..	..	..	1,156	..	..	118	..	..	..	..	65	..
Ngong Training Depot	249	..	..	130	..	..	..	..	449	..	..	..	..	..	..	..	212	..
Lumbwa	..	1,596	..	..	..	..	..	..	485	..	..	..	..	..	..	..	..	..
Maseno	1,604	33	..	4	2	..	..	..	..	..	..	..	..	..	..	32	..	..
Alego, N. Gem, Samia, and N. Ugenya ..	10,151	..	..	2,405	..	..	63	..	..	..	..	..	..	..	..	475	..	..
TOTAL ..	52,158	72,491	988	5,436	23,758	..	25,113	73	42,739	..	202	118	1,203	447	890	3,170	1,787	4,120

SUMMARY OF DOUBLE INOCULATIONS—

Adults—Native ..	52,158	Calves—Native ..	5,436	Re-Double Inoculations—Free ..	1,203
Farm ..	72,491	Farm ..	23,758	Double Inoculations	447
Trade ..	988	Trade ..	—	V. B. Tests—All Stock ..	26,003

TOTAL RINDERPEST INOCULATIONS .. 182,484

East Coast Fever.—Outbreaks of East Coast fever within the Molo " clean area " are recorded as 12, as compared with 3 during the previous year. This disease is undoubtedly extending, and this fact should be realised and appreciated by stock-owners in that district. It is difficult to say how far squatters' cattle are responsible, but it is satisfactory to observe that a very decided effort is being made by the stock-owners to remove all the squatter-owned cattle from the district.

Other diseases such as blackquarter, heartwater and trypanosomiasis have been recorded.

Mombasa.

No alterations in the Veterinary Staff during the year have been made. No outbreaks of rinderpest have been reported. East Coast fever is prevalent on the island and deaths have ocurred from this disease.

Importation of Stock—Table of Comparative Records.

The following animals arrived from overseas and were railed to up-country stations :

	1926	1927	1928
Horses	36	54 (12 S. Africa, 7 crossbred, 35 thoroughbred)	42
Mules	..	..	..
Cattle	52	130	80
Dogs	118	116	103
Sheep and Goats	Sheep 185	97	348
Pigs	16	10	25
Poultry	395	189	..
Cats	7	2	1
Red Deer	17	..	4
Guinea Pigs (for experiment) ..	..	50	..
Rabbits	..	35	19
Coastwise Traffic Arriving on Mombasa Island.			
Horses	..	..	..
Mules	..	..	2
Donkeys	57	76	10
Pigs	..	..	..
Cattle	323	2	5
Camels	30	11	1
Sheep and Goats	3,196	192	768

	1926	1927	1928
STOCK ARRIVED AT MOMBASA FROM UP-COUNTRY STATIONS.			
Cattle	526	477	450
Sheep	Sheep & Goats 50	..	..
Donkeys	..	12	..
STOCK DEALT WITH AT THE VETERINARY STATION, MAKUPA. ARRIVING BY ROAD FROM THE MAINLAND.			
Cattle	3,669	5,415	4,968
Donkeys	28	91	69
Pigs	9	12	..
Sheep and Goats	14,550	28,113	22,733

Inspection of Hides and Skins at Mombasa.

	1925.	1926.	1927.	1928.
Hides (bundles)	14,293 ...	11,985 ...	8,600 ...	8,544
Skins (bundles)	2,486 ...	1,060 ...	2,187 ...	3,184

Inspection of Slaughter Stock, Mombasa.

	1926.	1927.	1928.
Cattle	4,491 ...	5,663 ...	5,915
Sheep and goats ...	19,457 ...	19,910 ...	18,988

RINDERPEST SERVICE.

The Rinderpest Service functioned throughout the year at high pressure, as the following tables will indicate, and has amply justified its initiation.

Although it has not been able to cope with all district inoculations, it is hoped that in time, with the experience already gained, that it will be able to do so.

The service was in charge of Veterinary Officer Hudson, who towards the end of the year was posted as a Veterinary Research Officer at the Laboratory, Kabete, but owing to the large amount of work to be done still remained in charge.

In some instances extra work has been caused and considerable disorganisation by stock-owners withholding their cattle during district inoculations and later such cattle actually becoming infected with rinderpest, and owners requesting immediate attention.

Under such conditions it is difficult satisfactorily to carry out the immunisation owing to the complication of an already infected herd, and the difficulty of organisation of staff at short notice.

Such outbreaks have almost invariably resulted in serious mortality, which otherwise might have been prevented, and endanger susceptible cattle in neighbouring herds.

District inoculations are usually organised through District Associations, and it is hoped that stock-owners will in future recognise the advantage of having animals immunised during such inoculations and not undergo avoidable risks of natural infection, not alone as far as they themselves are concerned, but also the danger in which they involve susceptible cattle perhaps throughout the entire district.

The following table indicates the work carried out by the Rinderpest Service during the year under review :—

District	Double Inoculations	Virulent Blood Tests	Serum Alone Inocs.	Mortality (Approx.)
Nanyuki and Nyeri	8,033	130	..	..
Laikipia and Ngobit	9,720	18	..	..
Gilgil	2,061	890	..	..
Lumbwa	12,296	2,488	..	..
Burnt Forest	9,025	245	..	..
Uasin Gishu and Trans Nzoia ..	41,497	11,475	..	..
	82,637	15,246	..	1,525 or 1·6%

The above table comprised 58,523 head of adult stock and 24,114 head of calves.

Some 791 head of cattle included in the above figures were re-double inoculated owing to the fact that in a few cases rinderpest lesions were observed subsequent to contact with animals reacting to double inoculations.

Mortality amongst grade stock has been estimated at 1.6 per cent., and it is interesting to note that this corresponds exactly to that recorded during the year 1927.

Mortality from redwater and anaplasmosis was comparatively small, but drought, bad grazing conditions and consequent poor condition of the cattle directly affected mortality to a considerable extent.

Virus-makers were almost invariably infected by nasal discharge. This has a decided advantage over the in-contact method previously in operation.

In many instances tested virus-makers free from redwater and anaplasmosis were forwarded from the Laboratory for field double inoculations, especially in the non-endemic East Coast fever areas. The advantage of such a procedure is very obvious since it is difficult or impossible where dipping has been carried out to any extent, to obtain "clean" virus-makers from the farm or to know whether animals to be inoculated are susceptible or otherwise.

A noteworthy feature in the history of the Rinderpest Service was the request of the District Committee, Trans Nzoia District, that the double inoculation against rinderpest of all cattle within that district be made compulsory. Work was commenced during the month of November, and up to the end of the year over 50,000 head of cattle had been treated.

Nairobi Veterinary Quarantine Station.

This station was originally constructed and designed for the limited number of pure-bred cattle annually imported into this Colony and received at the Quarantine Station previous to the operation of the Government-assisted importation scheme.

During the year increased importations of cattle have been received, with the result that the accommodation at the Quarantine Station was insufficient, since most of these cattle arrived towards the end of the year. Extra accommodation was therefore provided at very short notice.

Imported Cattle Received at the Quarantine Station during the Year 1928.

Breed.	*Bulls.*	*Heifers.*	*Total.*
Black Welsh ...	3	—	3
Aberdeen Angus ...	1	—	1
D. Shorthorn ...	12	—	12
Blue Albion ...	2	—	2
Friesian ...	7	2	9
Ayrshire ...	12	5	17
Red Poll ...	8	—	8
Total ...	45	7	52

Imported Cattle under Government-Assisted Scheme Received at the Quarantine Station during the Year 1928.

Breed.	*Bulls.*	*Heifers.*	*Total.*
Black Welsh ...	2	—	2
Aberdeen Angus ...	1	—	1
D. Shorthorn ...	12	—	12
Blue Albion ...	2	—	2
Friesian ...	3	—	3
Ayrshire ...	8	2	10
Red Poll ...	7	—	7
Total ...	35	2	37

It may be observed that the total importations of cattle received at the Quarantine Station amounted to 52 head as compared with 35 the previous year.

It may also be observed that 7 different breeds are represented, and these breeds must of necessity leave a decided impression on the herds throughout the settled areas.

The Quarantine Station was primarily intended for the reception of cattle for the purpose of immunisation against piroplasmosis and anaplasmosis (redwater and gallsickness).

Mortality to the extent of 6 animals has been experienced the cause of which has not been fully determined, but is at present under research investigation.

Mortality has not been due to immunisation with the exception of one doubtful case.

Piroplasmosis and Anaplasmosis.

Technique of Immunisation and Description of Typical Reactions.

The immunisation of cattle against piroplasmosis and anaplasmosis (redwater and gallsickness) is carried out simultaneously. The first injection of blood from vaccine producer No. 8844 transmits anaplasma centrale—the mild form of gallsickness (the South African strain). The second injection of blood from vaccine producer No. 1167 transmits both piroplasma bigeminum—the casual organism of tropical redwater, and anaplasma marginale—the typical form of gallsickness.

Redwater has not been observed to occur from the first blood injection.

Blood smears are taken daily (or every third day) prior to the commencement of the reaction, and morning temperatures are recorded throughout the whole period.

Cattle are kept under observation for ten to fourteen days prior to inoculation, and, provided their behaviour is normal, they are then given the first inoculation.

First Inoculation—Transmitting Anaplasma Centrale.

5 c.c. of defibrinated blood from vaccine producer No. 8844 is injected subcutaneously. The average period of incubation when the parasites are present fairly frequently in the blood, is 39 days, with a minimum of 30, and a maximum of 50 days.

The duration of this reaction is about 23 days and is usually accompanied by a rise in temperature, diminished appetite, sometimes constipation, and icterus of the visible mucous membranes. With rare exceptions the degree of illness is not marked and medicinal treatment is unnecessary.

Towards the height of the reaction and depending upon its intensity, anaemia changes occur in the blood, the greater the frequency of parasites the more marked are these changes. Sufficient time should be allowed for this anaemia to clear up before giving the second inoculation because the redwater reaction usually occurs after an incubation period of ten days and a breakdown to anaplasma centrale may occur. This interval varies between 64 and 77 days.

Second Inoculation—Transmitting Piroplasma Bigeminum and Anaplasma Marginale.

5 c.c. of defibrinated blood from vaccine producer No. 1167 is injected subcutaneously. Piroplasma bigeminum are present in the blood after an average incubation period of 10 days—with a minimum of 7 and a maximum of 15 days. This reaction is usually accompanied by a marked rise in temperature, diminished appetite and constipation.

While the reaction may be accompanied by severe clinical symptoms, the parasites may only be sparingly present in the blood.

With the exception of very mild cases, trypanblau is injected subcutaneously to control the reaction, and the results have been entirely satisfactory. As soon as the temperature rises above 104° F., if the parasites are fairly numerous in the blood, the injection is given immediately. The appearance of blood in the urine has only been observed in one case, because treatment is adopted in the early stages before this symptom is likely to appear.

The temperature drops to normal about thirty-six to forty-eight hours after the trypanblau has been given and the after-effects of the reaction are much less marked than where the use of trypanblau has been delayed. This is important because it leaves the animal in a better condition to deal with the anaplasma reaction which occurs about three weeks later.

Technique of Trypanblau Injection.

The solution is freshly prepared immediately prior to use. 3 grms. of trypanblau are dissolved in 175 c.c. boiling water, well stirred and allowed to cool to about 80° F. before filtering. The temperature of the solution is then raised to body heat. For an average sized animal, such as an eighteen months old Shorthorn bull, 110 c.c. are injected subcutaneously. The injection is made in four places, on both sides of the neck and well behind the shoulder on each side. The skin at each point of injection is well massaged.

In only one case has abcess formation followed the use of trypanblau.

Anaplasma Marginale Reaction—Typical Gallsickness.

The average period of incubation of the marginale reaction is 34 days, with a minimum of 19, and a maximum of 51 days. This reaction is usually less marked than that of anaplasma centrale and of shorter duration, seldom exceeding 16 days.

Duration of Quarantine Period for Redwater and Gallsickness Immunisation.

The average period necessary to complete the redwater and gallsickness immunisation is 145 days, with a minimum of 136 and a maximum of 173 days.

Observations on Redwater and Gallsickness Immunisation.

(1) Cattle imported from South Africa vary widely in susceptibility to redwater and gallsickness. Some appear to be immune to anaplasma marginale but react to anaplasma centrale, while exceptionally the reverse is the case. A Friesian bull failed to react to two inoculations of blood transmitting anaplasma centrale. Other cattle inoculated with the same batch of blood on each occasion reacted well. It was therefore assumed that the bull was immune, and the second inoculation —transmitting redwater and anaplasma marginale—was given. There was no redwater reaction, but an exceptionally severe reaction to anaplasma marginale after an incubation period of nineteen days. The degree of illness was not less marked than a naturally contracted attack of typical gallsickness. Large pieces of mucous membrane were passed out with the fæces and the bull refused all food for ten days.

Had this bull been immune to anaplasma centrale, so severe a reaction to anaplasma marginale should hardly have occured. One might therefore assume that a failure to react to anaplasma centrale does not necessarily mean that the animal is immune. This is to a certain degree supported by the fact that cattle which do not react well to anaplasma centrale frequently react heavily to anaplasma marginale.

(2) The blood of vaccine producer No. 1167 may not always produce redwater in a susceptible animal. It has been noted in one instance that the first inoculation of this blood produced a reaction to anaplasma marginale but not to redwater. A subsequent inoculation gave a satisfactory redwater reaction. It should not therefore be assumed that because an animal fails to react to the inoculation, the animal is immune.

(3) The effect of breed and sex does not appear to play any important part in redwater and gallsickness immunisation. Provided cattle are of good stamina and constitution, all breeds stand the inoculation equally well. There is, however, probably less risk with younger animals.

Imported Dogs.

Provision is also made at the Quarantine Station for the detention of such imported dogs as it may be necessary to so detain under the Importation of Dogs Regulations.

The period of detention is at present 4 months, but the detention for a period of 6 months is under consideration.

During the year 10 dogs were accepted and detained in the Quarantine Station.

Settled Areas—General.

Rinderpest.

Immunisation against rinderpest has been the main method of control of this disease, although this method has been to some extent criticised in neighbouring territories.

If bovines were alone responsible for the spread of rinderpest, its total elimination would not present a problem impossible or impracticable of fulfilment. Such however is not the case since large herds of susceptible game are to be met with throughout the Colony, and so sanitary control measures cannot be applied in this respect.

The only alternative is, therefore, to confer on as many bovines as possible a life-long immunity.

It is difficult to say how long it may be necessary to carry out such immunity, but it is certain that until fencing is far more extensively brought into practice, that stock-owners must have made available for them this particular service.

Serum alone is expensive and immunity, if conferred, is of a temporary nature and the anxiety of remaining susceptibility is likely to obstruct advancement in the acquisition of pure-bred imported stock and general grading towards the higher type for dairy and beef production.

It is satisfactory to report that most of the stock-breeding districts of the Colony have now taken advantage of immunisation facilities afforded to them, but it is to be regretted that a number of well-known herds still remain susceptible, and that should rinderpest occur naturally amongst such herds, serious mortality and other economic losses must be expected.

The question of susceptible regularly dipped cattle no longer presents the difficulties previously experienced. Since for such cattle every effort is made to obtain virus makers from the Veterinary Research Laboratory which have been tested free from piroplasmosis and anaplasmosis, thus eliminating the risk of the direct transmission of these diseases with the virus of rinderpest, and incidentally the test carried out eliminates heartwater, a tick-borne disease which may be directly transmitted by blood.

Rinderpest blood kept at 0° C. and obtained from the Laboratory has been used on a few farms for immunisation. The results obtained have not been satisfactory to the extent of justifying this method of obtaining virus for general distribution to the field staff.

Virulent nasal discharge free from red blood corpuscles is now most generally used for the infection of virus makers : this method has the decided advantage of saving much time, over the previous method of contact.

Although increased immunisations have been carried out during the year it will be noted that there has been an actual increase in the number of outbreaks reported. These outbreaks have been, to a great extent, attributed, as previously mentioned, to transmission by game.

The reported outbreaks of rinderpest during the last three years are as follows :—

1926		1927		1928
71	...	73	...	63

East Coast Fever.

With regard to East Coast fever, the position is generally satisfactory. Stock-owners are gradually recognising not only the advantage but also the necessity of dipping operations. Many farms have been cleaned up in the northern clean area by the operation of dipping, and many farms, even in endemic areas, have been cleaned to the extent that stock-breeding and dairying, previously impossible, are now economic propositions.

Fencing, dipping and the elimination of squatter cattle are the best safe-guards and the greatest possible insurance which could be directed against invasions of East Coast fever.

The importance of fencing and dipping has been recognised to the extent that a Bill in this connection, drawn up on the lines adopted in other countries where East Coast fever exists, has been under Government consideration and has the entire support of many districts.

It cannot be too often or too clearly impressed on stock-owners that an early diagnosis of this disease may have a very important relative bearing on the extent of the outbreak, and for this reason it is desirable that the very first case should be diagnosed; this can only be done with certainty where a routine practice is observed of taking specimens for diagnosis, from all sick or dead animals.

Immunisation against East Coast fever has been the subject of much research at the Kabete Research Station (Laboratory) and so far results obtained have not justified field application.

The number of outbreaks reported and confirmed during the year 1928 was 51. The following table indicates the number of fresh outbreaks in "clean" areas during the past three years:—

Area.	1926	1927	1928
Northern clean area ...	47	37	38
Molo clean area ...	8	3	12
Limuru clean area ...	2	4	1
Totals ...	57	44	51

The following table shows the number of quarantines for East Coast fever which were revoked during the past three years:—

Area.	1926	1927	1928
Northern clean area ...	3	18	32
Molo clean area ...	4	7	3
Limuru clean area ...	—	1	1
Totals ...	7	26	36

Contagious Bovine Pleuro-pneumonia.

Pleuro-pneumonia presents a problem far more complicated in its control, since an animal apparently recovered, may still remain infective for a period which is comparatively long, but not yet definitely determined. Thus it is that on an infected farm, long after all clinical appearances of the diseases have disappeared, a fresh case or cases may occur, without any history of re-infection.

The disease is often slow in extension and may take a long time to progress through a herd. Some animals show a high resistance and only become infected after prolonged exposure to infection.

The settled areas are comparatively free from this disease and only sporadic outbreaks have occurred. Immediate isolation and slaughter of all clinically infected animals and vaccination of the non-infected, have given fairly satisfactory results. The danger lies in an apparently recovered animal.

Many of the native reserves are infected with contagious bovine pleuro-pneumonia, and the greatest vigilance should be observed amongst all concerned to prevent illicit movement of cattle from such infected areas.

The reported outbreaks of contagious bovine pleuro-pneumonia during the last three years are as follows :—

1926		1927		1928
11	...	20	...	8

Heartwater (*Rickettsia Ruminantium*).

Heartwater would appear to be more prevalent than the actual number of reported outbreaks indicate.

The difficulty of a farm diagnosis is very apparent since the symptoms usually observed are not always specifically diagnostic, and fresh specimens of brain, kidney or spleen are required for microscopic examination.

This disease, to which cattle, sheep and goats are susceptible (though sheep and goats would appear to be more susceptible than cattle), has a fairly wide distribution, and has been reported from the districts of Laikipia, Molo, Naivasha, Gilgil, Lumbwa and Nairobi.

The mortality in cattle may be as high as 20 per cent., but in sheep and goats the mortality may be much higher.

The disease is tick-borne, and the ticks *Amblyomma variegatum* and *Amblyomma habreum* are definitely known to be transmitters, and are the host ticks. Should the larvae feed on an infected animal the nymphal stage becomes infective, and still remains infective even if fed on an animal not susceptible to heartwater. Should the nymphae become infected the adult stage will be infective.

Artificial immunisation has been the subject of research, but results have not been satisfactory, consequently tick-eradication should be aimed at as the only method of dealing with the disease.

Trypanosomiasis.

There has been an appreciable reduction in the number of outbreaks of this disease as compared with last year. On infected farms many attempts have been made to find tsetse fly, but in a few instances only with success. It may be that large game like elephant and buffalo are responsible for such infrequent invasions of fly.

Anthrax.

The number of reported outbreaks of anthrax continue to increase from year to year. This increase is, however, not regarded as an actual increase in the incidence of the disease, but rather as an indication that greater attention is being devoted to the diagnosis of disease generally, and that a greater number of specimens are presented for microscopical examination.

Death from anthrax most frequently occurs suddenly, and in the case of all sudden deaths amongst stock, the greatest care should be observed not to carry out a post-mortem examination until microscopical examination of blood smears has proved negative, thus diminishing the human risk and the spread of further infection on the farm.

The issue of a single (spore) vaccine by the Veterinary Research Laboratory is under consideration and experimental investigation.

Foot and Mouth Disease.

Although a quarantine is not now imposed on infected farms, the disease still remains a notifiable one, and it is satisfactory to note that outbreaks reported during the year show a decided decrease on the number reported last year. It is impossible to account for the source or sources of infection of sporadic outbreaks which occur without previous history of infection.

Contagious Abortion.

Confirmed outbreaks of this disease exceed in number those reported last year, but it is considered that again this merely indicates a greater anxiety on the part of stock-owners to have the disease definitely diagnosed, rather than any appreciable increase in the disease, which is believed to be fairly prevalent throughout the settled areas, and possibly in the native reserves. All that is required for the diagnosis of this disease is a small quantity of blood from the suspected animal to be used for the agglutination test at the Research Laboratory.

This disease is intimately associated with sterility, and the loss of the foetus is not generally the only loss sustained, since sterility is frequently a sequel.

On certain farms where infection is extensive, vaccinations of heifers before mating has given good results.

Horse Sickness.

Horse sickness, although it did not appear in the form of an epidemic, has been more prevalent than during the last few years. In a few instances mortality was serious, and a few stables had quite severe outbreaks.

The actual medium of infection still remains a problem, but it is a fact that animals kept during the night in fly-proof stables rarely contract the disease.

Ulcerative and Epizootic Lymphangitis.

Better care and management of horses and mules has undoubtedly reduced the incidence of these diseases. The careful disinfection of all abrasions, wounds, etc., as soon as possible after infliction, and tick-free conditions, help very materially to reduce outbreaks.

TOTAL RINDERPEST IMMUNISATION AND TESTS CARRIED OUT THROUGHOUT THE SETTLED AREAS.

The undermentioned rinderpest inoculations were carried out during the year :—

AREA	Double Inoculations	Virulent Blood Tests	Serum Alone Inoculations
SETTLED AREAS—			
(*a*) *By District Staffs.*			
Nairobi	1,304	..	..
Gilgil	11,648	..	..
Lumbwa	1,596	..	..
	14,548	..	..
(*b*) *By Rinderpest Service in Settled Areas.*			
Nanyuki and Nyeri ..	8,038	130	..
Laikipia and Ngobit ..	9,720	19	..
Gilgil	2,061	890	..
Lumbwa District	12,296	2,488	..
Burnt Forest Area	9,025	245	..
Trans Nzoia and Uasin Gishu	41,497	11,475	..
Total ..	82,637	15,247	..

VETERINARY INOCULATION STATION. IMPORTED BULL BEING INOCULATED AGAINST REDWATER AND ANAPLASMOSIS.

VETERINARY INOCULATION STATION IMPORTED BULLS.

REPORT OF OUTBREAKS OF ANIMAL DISEASES, SETTLED AREAS, FOR THE PAST THREE YEARS.

Disease.	*Number of Outbreaks:* 1926.	1927.	1928.
Rinderpest	71	73	83
East Coast Fever	58	31	37
Pleuro-pneumonia	11	20	8
Blackquarter	11	22	18
Trypanosomiasis	6	11	6
Foot and Mouth Disease	9	22	7
Sheep Pox	1	2	—
Horse Sickness	13	8	18
Ulcerative Lymphangitis	38	42	27
Epizootic Lymphangitis	17	7	7
Swine Fever	3	2	7
Contagious Bovine Abortion	2	1	9
Anthrax	7	27	43
Anaplasmosis	—	—	15
Heartwater	—	—	7
Equine Piroplasmosis	—	—	1
Piroplasmosis	—	—	9
Muthiuko (Turning Sickness)	—	—	5

RETURNS FROM GOVERNMENT DIPPING STATIONS FOR THE YEARS 1926, 1927 AND 1928.

STATIONS	EQUINES			CATTLE			SHEEP AND GOATS		
	1926	1927	1928	1926	1927	1928	1926	1927	1928
Nakuru ..	251	15	36	7,620	7,941	6,974	10,099	19,538	15,442
Gilgil	..	147	2	..	9,590	9,048	..	..	..
Isiolo	260	..	121	..	280	921	37,314	21,700	80,015
Nanyuki ..	88	..	..	24,551	13,977	19,278	..	..	..
Rūmuruti ..	..	..	..	..	..	1,400	..	..	..
Eldoret	..	..	..	..	..	..	603	..	706
TOTALS ..	599	162	159	31,171	31,788	37,621	48,016	41,238	96,163

SLAUGHTER STOCK, NAIROBI.

The following table indicates the numbers of stock slaughtered at the Nairobi Abattoir during the years 1926, 1927 and 1927 :—

	1926.	1927.	1928.
Cattle	10,427	10,811	12,107
Sheep and goats	20,901	23,683	27,610
Calves	—	485	—
Pigs	704	929	1,139
Other animals	—	—	113

Of the above animals the undermentioned numbers of carcases were condemned as unfit for human consumption :—

864 cattle condemned, chiefly for measles.

154 sheep and goats condemned, chiefly for dropsy and pleuro-pneumonia.

6 pigs condemned, chiefly for tuberculosis.

2 other animals condemned on account of abscesses.

Brands.

The following particulars are shown in respect of the registration of brands during the year :—

Brands registered	121
Brands transferred	5
Brands cancelled	1
Number of "S" brands supplied to individuals	60
Number of Departmental brands supplied	176

Honorary Permit Issuers.

I wish to take this opportunity of recording my grateful thanks to all Honorary Permit Issuers for the help and assistance which they have accorded to this Department during the year.

Part III.—Native Reserves.

Ngong Veterinary Training Staff.

European Staff.

Officer in Charge.—Senior Veterinary Officer Dixon.

Stock Instructor.—Mr. A. J. Anderson.

Stock Inspectors.—

Mr. J. Greig (28-1-28 to 1-6-28).

Mr. E. J. O'Hara (1-6-28 to 29-11-28).

Native Staff.

Sergeant Instructor : 1.

School Instructor : 1 (for instruction in Ki-Swahili).

Artisan Instructor : 1.

The Ngong Training Depot is situated at the foot of the Ngong Hills, and on the head-waters of the Mbagathi River, and is admirably located for the purpose for which it is required. It comprises an area of approximately 2,000 acres, and has been completely fenced.

A bore-hole has been sunk to a depth of 250 feet, which yields about 5,000 gallons of water in 24 hours. This water is pumped by a wind-mill. Two-and-a-half miles of piping have been laid from the main water supply, the Mbagathi

River, and this water is distributed to various paddocks, and for domestic purposes by a Blake's " B." hydraulic ram. This is the first satisfactory bore-hole which has been sunk throughout the entire Masai Reserve.

Cow sheds were erected of concrete blocks, and iron roof, with heat-proof ceiling and completely equipped with general dairy utensils.

These buildings were planned by the staff, and entirely erected by Masai craftsmen.

Pupils from the following Native Reserves have been accepted for tuition :—

Pupils	Received	Passed out Trained Scouts, etc.	Returned to Reserve	Remaining
Turkana	8	Nil	1	7
Samburu	22	,,	5	17
Masai	10	,,	1	9
Jaluo	34	32	Nil	2

Educational work mainly consists of practical demonstrations in veterinary procedure, *i.e.*—

(1) Recognition or normal and pathological animal condition.
(2) Immunization against diseases.
(3) Preparation of specimens for diagnosis.
(4) Post-mortem, technique.
(5) Tick eradication.
(6) Technique of Castration.
(7) Reading and interpretation of thermal reaction.

Demonstrational work in a routine way was also afforded in :—

(*a*) Flaying.
(*b*) Preparation of hides and skins, shade-drying, etc.
(*c*) General principles of selective breeding.
(*d*) Double hand milking, and hand-rearing of calves.
(*e*) Cutting, preparation, and storing of hay.
(*f*) Breaking and general preparation of land, and growing of food crops.

Demonstrational immunization has been carried out as follows :—

DETAILS OF INOCULATIONS, ETC., CARRIED OUT.

Double Inoculation against Rinderpest.

	ADULTS	CALVES	MORTALITY
Depot Herd ...	40	16	Nil
Masai Herds ...	148	61	Nil
Kikuyu herds seized for breaking quarantine ...	61	53	Nil
	249	130	Nil

Pleuro-pneumonia.

Depot Herd ...	105	—	Nil
Masai Herds ...	129	—	Nil
Kikuyu Herds ...	225	—	Nil
	449	—	Nil

Anthrax.

Depot Herd ...	196	16	Nil

Special facilities are available for work in connection with preparation, flaying, and shade-drying of hides, since slaughtering arrangements for cattle from the Masai Reserve are carried out in the immediate neighbourhood of the Depot and all such hides are prepared under the supervision of the officer in charge of the Depot.

The following table shows the numbers of cattle exported for slaughter from the Masai Reserve during the year :—

SLAUGHTER CATTLE EXPORTED FROM THE MASAI RESERVE TO NAIROBI, PER MONTH, DURING THE YEAR ENDING 31-12-28.

January	74
February	417
March	549
April	527
May	582
June	688
July	656
August	668
September	663
October	959
November	836
December	705
Total ...	7,324

The breeding herd of dairy cattle now comprises 122 head of adults and a number of calves and working oxen. The entire herd of cattle amounting to 247 head.

The milch cows and heifers are all of the native type, and are being mated with Boran bulls, which are considered to be the best milking, and general utility types.

Milking records are kept for the purpose of demonstration of breeding by selection, and feeding experiments in hand rearing of calves have been carried out.

Records of milk yield for certain animals, for full lactation period are not yet completed, but the following table serves to show that the milk yield of native cows kept under satisfactory conditions is very appreciable, and a definite increase has been observed, since these cows were allowed to graze during the night, instead of confinement to bomas, as is the accepted custom. This has been made possible by the existing system of fencing.

MILK YIELD FROM THE DATE OF CALVING TO 31-12-18.

Cow No.	Date of Calving	Total Yield	Average Daily Yield
		lb.	*lb.*
20	23–6–28	639	3·31
48	24–6–28	1,021	5·32
26	2–7–28	582·5	3·1
29	16–8–28	281·75	1·99
21	9–9–28	467·75	4·92
58	10–9–28	1,084	10·03
2	16–9–28	808·5	8·42
15	8–10–28	840·5	9·88

There is further appended a table of milk analysis; the milk was examined fourteen days after calving :—

COPY OF MILK ANALYSES.

Taken 14 days after Calving.

Lab. No.	Cow No.	Specific Gravity	Fat	Total Solids	Solids not Fat
312 ..	3	29	6·0	14·6	8·6
313 ..	26	32	3·0	11·25	8·25
369 ..	21	33	5·0	14·4	9·4
370 ..	56	34	5·0	14·65	9·65
	15	35	4·8	14·65	9·85
	21	35	6·1	16·21	10·11
	48	34	4·6	14·16	9·56

Water from the sources of supply—

(*a*) Main water supply,

(*b*) Bore-hole,

(*c*) Brackish stream,

has been analysed as follows by the Agricultural Chemist :—

	C.A.O. parts per 100,000 gallons.		C.A.O. grains per gallon.
(*a*)	1.50	...	1.05
(*b*)	4.78	...	3.35
(*c*)	12.80	...	8.96

It may be noted that the supply (*c*) is very rich in lime; it is much appreciated by the cattle and should serve a useful purpose in building up bone, and size.

In order to test the feeding capacity of the prevalent grasses through the Depot, samples have been forwarded to the Rowett Institute, Aberdeen, for detailed analysis, but it is regretted that reports have not yet been received.

In connection with the hand-rearing of calves experimental work, calves are weighed at time of birth, and every week until about one year old. The following table shows certain weights recorded until the end of the year :—

Calf Weights taken Weekly from Date of Birth to 31-12-28.

No. of Cow	Date of Birth	Weight at Birth	Sex	Weight at 31–12–28	Weekly Increase
		lb.		*lb.*	*lb.*
48	24–6–28	32	Bull ..	185	7·4
3	26–6–28	34	Heifer ..	185	7·4
35	23–8–28	35	Bull ..	119	6·61
21	9–9–28	28	Heifer ..	114	7·61
58	10–9–28	35·5	Heifer ..	105	7·00
2	16–9–28	39	Bull ..	95	6·64
31	27–9–28	35	Bull ..	87	6·69
15	8–10–28	39	Bull ..	69	6·87

Milk Ration fed to Calves.

Each calf had a daily ration of 5 lb. of whole milk from the date of birth to the end of the year ending 31st December, 1928, with the exception of calves Nos. 48 and 3, who received whole milk ration up to 31-10-28 and then for the remainder of the year received 2 lb. of whole milk and 3 lb. water. These calves should rightly have been off the milk entirely, but owing to the small number of cows milking at the time the yield was not sufficient to do separating, etc., and therefore the animals had the benefit of consuming any milk left over from the other calves' rations.

Concentrates Consumed per Month. (Mixture : Simsim Cake, 1 lb.; Bran, ½ lb.; Maize Meal, 1 lb.)

Pen No. 1

September	11¾ lb.	(Calves 48, 3)
October	17 ,,	(,, 48, 3, 35)
November	62 ,,	(ditto)
December	60 ,,	(ditto)

Pen No. 2.

October	4 lb.	(Calves 21, 58, 2)
November	5½ ,,	(ditto)
December	12 ,,	(ditto)

Pen No. 3.

October	1½ lb.	(Calves 31, 15)
November	2½ ,,	(ditto)
December	5 ,,	(ditto)

All these experiments and investigations are being carried out in close conjunction with the Rowett Institution at Aberdeen.

Nyanza Province.

During the year Major Brassey Edwards applied for and was granted a small area of land, through the courtesy of the Acting Senior Commissioner of the Province, comprising some 250 and 300 acres at Maseno.

This land is to be used for native educational demonstration work with regard to the general principles of animal breeding, flaying, preparation and shade-drying of hides and skins, ghee making, etc.

The area has not yet been completely surveyed but certain definite boundaries are at present being fenced; in addition arrangements have been made for the construction of two portable houses to be erected at this station.

Rinderpest.

The main activity of the Department in the Native Reserves of the above Province was directed towards immunization against rinderpest.

The number of animals dealt with throughout the entire Kavirondo Reserve shows a decided decrease as compared with former years, but this is accounted for to some extent by the fact that most of the adult cattle have already been immunized in previous inoculations, leaving only the annual increase susceptible. Also, owing to previous inoculations, outbreaks of rinderpest have been fewer in number, and natives are much disposed to wait until a natural outbreak is imminent or has occurred, before presenting their cattle for inoculation with the consequent necessity of paying fees.

Before technique of immunization was brought to its present successful standard, certain mortality was experienced from redwater and anaplasmosis, and it will take some time to fully restore confidence.

In Central Kavirondo, trypanosomiasis is prevalent and this leads to difficulty in obtaining virus makers, since should a virus maker be infected with trypanosomiasis and its blood used for double inoculations, this disease would of necessity be extensively distributed.

It is hoped, however, to overcome this difficulty by treating the citrated blood with potassium antimony tartrate or by the provision of trypanosome-free virus makers from the Laboratory.

There is at present no staff in South Kavirondo.

In the South Lumbwa district a number of cattle have been dealt with in the station at Sondu. This station is not entirely suitable, as it is located at one end of the district and the natives are not altogether in favour of bringing their cattle long distances.

A number of native cattle are, however, annually dealt with on farms in the Kericho-Buret and Sotik settled areas. This number is increasing, and it is hoped that all cattle in these areas from the Reserve will eventually become immunized.

The following table shows the numbers of animals immunized or tested for rinderpest for the districts of North and Central Kavirondo, South Lumbwa and Nandi Native Reserves.

District and Location.	Central Station.	Total No. dealt with.	Double Inoculations.	Virulent Blood Tests.	Inoculations of Calves.	Estimated Mortality.
NORTH KAVIRONDO						
North Kitosh	Kitai ..	4,477				
South Kitosh	Bungoma	4,302				
Ohaya and Waima ..	Magero's..	3,377	13,462	54	2,894	3%
Wanga ..	Osundwa's	2,818				
Marach ..	Oduya's ..	1,436				
CENTRAL KAVIRONDO						
Alego ..	Alego ..	5,985	4,216	..	1,769	
North Gem	North Gem	1,559	1,273	..	286	4%
Samia ..	Samia ..	1,946	1,799	63	84	
North Ugenya ..	North Ugenya ..	3,129	2,863	..	266	
Seme ..	Seme ..	1,075	1,075	..	..	2%
Kisumu ..	Kisumu ..	533	529	..	4	
Nyakatch ..	Nyakatch	967	967	..	..	7%
Kibigori ..	Kibigori ..	3,246	3,140	106	..	5%
SOUTH LUMBWA						
Location I ..	Sondu ..	1,012	1,012	..	..	6%
NANDI						
Nandi		10,184	8,720	1,464		
TOTALS						
North Kavirondo ..		16,410	13,462	54	2,894	
Central Kavirondo ..		18,440	15,862	169	2,409	
South Lumbwa		1,012	1,012	..	..	
Nandi		10,184	8,720	1,464	..	
GRAND TOTAL ..		46,046	39,056	1,687	5,303	4·5%

Pleuro-pneumonia.

Pleuro-pneumonia has not yet been observed or brought to notice in the North Kavirondo Reserve.

In Central Kavirondo, however, this disease is prevalent, and some 4,000 head of cattle have been vaccinated at the Kibigori station, but owing to difficulty in obtaining a reliable vaccine such cattle could not be released for general distribution.

In the South Lumbwa District this disease is also prevalent, but there is no doubt that when such a vaccine is available the disease will, to a great extent, be checked.

Trypanosomiasis.

A survey was carried out in Alego, Samia and North Ugenya. It all these locations trypanosomiasis infection was observed. Tsetse flies were found to be prevalent in Samia and Alego, but were not found in North Ugenya. The natives in the latter district are anxious to have their cattle treated for trypanosomiasis, but should such treatment be carried out it is very certain that the cattle would again be returned to infected areas, and the result of treatment would not only be nullified, but would also be likely to prejudice the natives against other veterinary operations.

Hides and Skins.

Several shade-drying bandas were erected during the year, others are under construction, and much work was done by the staff in all districts in connection with the better preparation of hides. The difficulty still remains, however, of demonstrating to the native the advantage of taking so much trouble when the trader does not discriminate between well prepared and badly prepared hides and skins.

Native Dairies.

The supervision of the Local Native Council Dairy at Kisianu has recently been taken over by the staff and as many as 50 gallons of milk are received daily. The stock inspector exercising the immediate supervision is a trained dairy expert and results valuable and of material benefit should soon become apparent.

Kerio Province.

Work in the Kerio Province has been considerably hampered by drought and consequent lack of grazing and inoculations were therefore confined to a very small period of time when grass was available. Inoculations were, however, carried out at the Molo River Camp, Timboroa Quarantine Station and the Njemps Quarantine Camp, as per the table below :—

Station	Double Inoculations	Virulent Blood Tests	Pleuro-Pneumonia Vaccinations
Molo River Quarantine ..	126	29	609
Njemps Native Reserve ..	4,973	4,739	..
Timboroa Quarantine Station..	4,495	1,010	2,120
Total ..	9,594	5,778	2,729

Several outbreaks of redwater occurred amongst cattle inoculated at Timboroa and some at Njemps. These outbreaks were mostly dealt with by subcutaneous injections of trypanblau.

Rinderpest immunisation is further complicated by the fact that certain areas in the Province are " fly " infected and the greatest vigilance has to be observed to ensure that virus makers do not harbour trypanosomes and that cattle are not indiscriminately moved from non-infected areas to infected areas for the purpose of such immunisation; although very many virus makers were utilised for the preparation of rinderpest virus, in no single instance were trpanosomes observed in the blood during the course of preliminary examination.

Hides and Skins.

In addition to these inoculations, considerable time and attention of the Veterinary Staff were given to instructional work in the preparation of hides and skins. During the year two native scouts received instruction at Kisumu and were detailed for duty in the South Kamasia Reserve. They have erected shade-drying sheds at all the bomas of the Chiefs and have given practical demonstrations. Two more native scouts were trained and sent to Kabarnet for similar work amongst the Suk and under the immediate control of the District Commissioner.

The preparation of hides and skins generally in this Province is not satisfactory. The Acting Senior Commissioner is giving the matter personal attention and facilities at veterinary camps have been afforded for the demonstration of better methods, such as are demanded by the market. It is therefore hoped that material improvement will very soon be noticeable.

During the year a report of the industrial conditions relative to stock was submitted by Captain R. Scott Little, Veterinary Officer, on the Suk and Turkana Reserves. In this report special emphasis was attached to the periods of drought which occur from time to time causing mortality amongst cattle to an extent estimated at about 40 per cent.

Ukamba Province.

No actual outbreaks of rinderpest have been recorded in the Ukamba Native Reserve during the year, and consequently inoculations against rinderpest were not carried out to any appreciable extent, the entire number immunised being 3,087 head, and further, the lack of grazing necessitated the closing down of the Machakos Veterinary Quarantine Station.

The Waterfalls Quarantine Station remained closed throughout the year.

An application has been made for the provision of a portion of the Machakos Township, including the present Quarantine Station comprising some 1,000 acres, as a Veterinary Educational Centre for the native areas of the Ukamba Province.

A Veterinary survey of the Ukamba Native Reserve was commenced in July, 1928, and is still in progress, with the object of ascertaining the stock census in relation to the carrying capacity of the Reserve. This survey is being carried by locations and specimen reports in respect of two locations already dealt with are appended hereto :—

Kangundo Location.

Cattle—	
Adults	12,449
Calves	3,228
Sheep	2,955
Goats	16,071
Cultivation, acres	4,000
Area of location, acres	50,000
Grazing capacity, head per acre	1—6
Percentage of males of females	1—3

This location should therefore accommodate 8,000 head of cattle only.

Matungulu Location.

Cattle—	
Adults	10,683
Calves	2,919
Sheep	1,957
Goats	7,054
Cultivation, acres	5,200
Area of location, acres	45,000
Grazing capacity	1—10
Percentage of males to females	1—4

This location should therefore accommodate 5,000 head of cattle only.

It was unfortunate that owing to the invasion of locusts into the Ukamba Reserve this survey had to be temporarily interrupted as it was considered necessary that the Veterinary staff should assist the Administration in locust destruction when trampling by cattle was considered necessary for this purpose.

Kikuyu Native Reserve.

Rinderpest is endemic throughout the Native Reserves of the Kikuyu Province and considerable mortality from rinderpest occurs annually.

Several attempts have been made to impress upon the natives of this Province the advantage of immunisation against rinderpest, without any general response. All headmen, however, are not adverse to inoculations; many of them realise the advantages of the life-long immunity and have asked for special inoculations. Such a procedure would, however, be impossible without the general consent, since cattle in neighbouring locations would also invariably become infected.

The Native Reserves of this Province are all endemic East Coast fever areas, all adult cattle are therefore immune to East Coast fever and would realise a high market price as working oxen if the natives were predisposed to have immunisations carried out.

The natives are neither entirely pastoral nor entirely agricultural. Their food supply does not therefore depend upon their herds, and sheep and goats. Nevertheless they practically consume almost the entire output of sheep exported annually from the Northern Frontier Province. Hides and skins do not constitute an important export trade, almost all of which are used for domestic purposes, clothing, etc.

These Reserves are free from pleuro-pneumonia.

One serious outbreak of anthrax occurred during the year in the Meru district.

Coast Province.

Veterinary activity in the Coast Province is very difficult of operation as such large areas are infected with East Coast fever and trypanosomiasis.

No outbreaks of rinderpest have been reported during the year, nor has pleuro-pneumonia been observed.

An Indian Veterinary Assistant is stationed at Mombasa, and in addition to his port duties a certain amount of time and attention is given to native work.

The question is also under consideration of placing another Indian Veterinary Assistant at Lamu.

The Mombasa main meat supply is derived from cattle, sheep and goats from the Northern Frontier Province, Digo, Teita and Malindi districts and a limited number from the Ukamba Province.

Masai Province.

The Senior Veterinary Officer in charge of the Veterinary Training Depot, Ngong, is also in veterinary charge of the Masai Province.

Certain parts in this Province are endemic East Coast fever areas and other parts are apparently free from infection.

Rinderpest seems to be always present and most of the cattle obtain natural immunity before they reach the adult stage.

Pleuro-pneumonia still exists in the Masai Province, but does not seem to be making many fresh invasions, probably to some extent due to quarantine imposed by the natives themselves.

There is a large export trade in hides and skins, but the market demand for these hides which are of good quality is not keen on account of the extensive system of branding by hot irons carried out throughout the Reserve. Such branding apparently causes permanent deterioration and many of the hides are not suitable for manufacturers. Every endeavour should be made to convince the Masai that such a system of branding detracts from market values and therefore a considerable amount of money is consequently lost to the Reserve.

Pupils from the Masai Reserve at the Veterinary Training Depot, Ngong, show a very intelligent interest in the subjects of instruction and seem to be very anxious to gain experience in ghee making and the preparation of hides and skins.

Northern Frontier Province.

The Northern Frontier Province cannot be readily compared with any other native area in this Colony. Vast tracts of bush and arid grazing with infrequent water holes. Drought often succeeds drought, resulting in extreme emaciation of cattle, which emaciation if not the direct cause of mortality lowers the constitutional resistance to such an extent that disease follows, with the inevitable result.

The entire area is free from East Coast fever, but rinderpest and contagious bovine pleuro-pneumonia seem to be ever present, outbreaks of which occur from time to time.

Pleuro-pneumonia is particularly prevalent in the Samburu reserve and vaccinations for this disease were carried out during the year.

The tribes are of necessity nomadic. They are in the dry weather constantly on the move in search of grazing and water. This fact renders veterinary operations in the nature of immunisation to disease, practically impossible. Even if grazing was easily available large concentrations of cattle are undesirable, since disease such as pleuro-pneumonia might easily make fresh invasions before immunisations could take place.

The quarantine system of disease control would seem to be applicable, the country is thinly populated. The natives according to custom have resorted to such regulations for their manyattas. It should not be difficult, and I believe the natives

would entirely co-operate, to give those quarantines official status, and to regard their observations as serious and necessary measures of sanitary control.

Statistics showing the cattle population of the Northern Frontier Province are not available, but it is thought that the cattle population is very great and although export to any appreciable extent, with available resources, cannot be developed at present, it is possible that ways and means may be found in time to utilise in a commercial way, all surplus stock before devastation by drought.

The Northern Frontier Province during the last year exported approximately 70,000 head of sheep and goats, about 60,000 of which passed through Isiolo and the remainder through Garba Tulla and Lamu. The sheep trade is thus obviously established but requires far greater extension, well considered fostering and encouragement.

With this object in view, a number of Black-faced Persian rams and ewes have been imported, and the appended scheme put forward by Captain Mulligan, Veterinary Officer, Northern Frontier Province, has been approved and is to be put immediately into operation :—

" The following tentative proposals are put forward for commencement of sheep breeding research, at Isiolo, for the Northern Frontier Province. It is essential that such research should be carried out along definite lines with definite objects in view.

These objects may be described as follows :—

(1) Improvements in size, bone and conformation.
(2) Improvement in quality of mutton.
(3) Improvement in quality of skins.
(4) Earlier maturity.

Together with the retention of such favourable heritable characters as resistance to disease and adaptability to environmental conditions.

For these purposes it is recommended that the following flocks be acquired.

(*a*) 150 ewes of average Gabbra or Boran type, native to the province.
(*b*) 100 ewes of average Masai type.
(*c*) 50 ewes of average Samburu type.
(*d*) 70 ewes Black-faced Persian type, already imported
(*e*) Rams, Boran or Gabbra (2)
Masai (6)
Black-faced Persian (8)

(*a*) 1. Fifty Gabbra or Boran ewes to be mated with two rams of the same type and this flock to be used as a control flock.

2. Fifty Gabbra or Boran ewes to be mated with two rams Black-faced Persian type.

(*b*) 1. Fifty ewes of Masai type to be mated with two Masai rams of similar type.

2. Fifty ewes of Masai type to be mated with two rams Black-faced Persian type.

(*c*) 1. Fifty ewes of Samburu type to be mated with two rams Black-faced Persian type. ...

(*d*) 1. Thirty ewes of Black-faced Persian type to be mated with two rams Masai type.

2. Forty ewes Black-faced Persian type to be mated with two rams Black-faced Persian type to maintain a pure-bred flock which would also be used as a control flock.

These flocks should be acquired with regard, as far as possible, to uniformity of age.

The average weights of non-pregnant ewes of individual flocks should be recorded, and in addition characteristic colour.

Accurate data should be recorded of :—

(1) Weight at birth, sex, and colour.
(2) Average weight each succeeding month.
(3) Mortality and resistance to disease.
(4) Fertility and breeding capacity.
(5) Age suitable for slaughter and breeding purposes.
(6) Quality of skins.

Each flock should be herded separately, and managed in the way most nearly approaching the native method, with the exception of mating conditions, medicinal treatment for gastric and intestinal parasites, and perhaps vaccine treatment for pleuro-pneumonia.

Native Chiefs and Headmen might be encouraged to visit Isiolo during the course of these experiments, and have explained to them the reasons and objects in view.

It is further recommended that this work be carried out in conjunction with the animal husbandry experiments by the Rowett Institute and in close co-operation with the Ngong Training Depot.

These experiments are to be carried out at Isiolo Quarantine Station, which has been specially prepared for such a purpose, by the erection of a sheep dip, fencing of paddocks and the erection of suitable buildings.

This station will therefore function more particularly as an industrial station for the Province, and in addition to the experimental breeding of sheep and supply of rams, etc., other activities will be pursued, such as demonstrations in the preparation and shade-drying of hides and skins, ghee making, medicinal treatment for gastric and intestinal parasites, and for immunisation treatment of cattle when requested.

There is in addition a very large export trade in hides and skins. The hides are generally well prepared and not mutilated by brands to the extent observed in hides from Masailand. There is, however, much room for improvement, and a stock inspector, who has had a special training for this work, has been posted to Isiolo."

Veterinary Services—Native Reserves.

General.

It was considered that a linking up of the Veterinary Services in Native Reserves and co-ordination under one authority, would materially help towards the uniformity of a policy to be pursued with regard to the economic development of stock throughout the reserves.

With this object in view Major Brassey Edwards, Deputy Chief Veterinary Officer, was detailed for this purpose. Later, however, and before organisation could be arranged, through an unfortunate illness, Major Brassey Edwards was obliged to proceed to England on sick leave.

Captain Mulligan, Veterinary Officer, was then detailed to carry on the work during the absence of Major Brassey Edwards, but owing to other duties he has not been able to devote such time and attention to this work as would have been desirable.

Various activities were, however, put into operation including immunisation to disease, instruction in the flaying and shade-drying of hides and skins, instruction in ghee making, stock surveys, etc.

The same difficulty as prevailed during the previous year regarding hawkers and small itinerant traders purchasing hides and skins has been experienced. These traders rarely, if ever, make any distinction in regard to price between well-prepared shade-dried hides and hides badly prepared and of low grade.

Very frequently hides are purchased in bundles unopened for inspection, which often include domestic hides, and in some cases even the hides of wild animals.

Little attention is given to methods of folding, which under certain circumstances may cause considerable deterioration.

With the object of overcoming these difficulties Government has under consideration certain Rules and Regulations which if put into operation would probably have the desired effect to some extent.

The trade in hides and skins constitutes in certain areas, such as the Provinces of the Northern Frontier and Masailand, a considerable portion of the entire trade of these Provinces and it is consequently of the first importance that this trade should be developed as far as possible and in accordance with market requirements.

There has been a considerable reduction in the number of cattle presented for inoculation in Native Reserves and at Veterinary Quarantine Stations. The reasons for this decrease were poor condition of stock due to prolonged drought, and vacancies for Veterinary Officers remaining unfilled, as previously mentioned.

The appended table indicates the number of rinderpest inoculations carried out at Veterinary Quarantine Stations in Native Reserves during the year 1928 :—

	Double Inoculations	Virulent Blood Tests	Serum Alone Inoculations
Kamasia Native Reserve ..	126	29	..
Kingwal (Nandi)	9,065	1,464	..
Kitai (North Kavirondo) ..	16,391	54	68
Machakos (Ukamba)	3,004	15	..
Kibigori (Central Kavirondo)..	3,887	106	..
Sondu (Lumbwa)	1,012	19	..
Nyakatch (South Kavirondo)..	967	..	..
Njemps	4,973	4,739	..
Chebororwa (Marakwet) ..	798	3,258	5
Timboroa (Uasin Gishu Masai)	4,495	1,010	..
Kisumu (Central Kavirondo)..	12,556	63	..
Ngong (Masai)	379	..	..
Maseno (Centrla Kavirondo)..	1,643	..	..
TOTAL ..	59,296	10,757	73

The undermentioned pleuro-pneumonia vaccinations were carried out at Veterinary Quarantine Stations in Native Reserves during the year 1928 :—

Kamasia	609
Timboroa (Uasin Gishu Masai)	2,120
Kitai (North Kavirondo)	849
Kingwal (Nandi)	654
Chebororwa (Marakwet)	4,103
Machakos (Ukamba)	252
Kibigori (Central Kavirondo)	3,625
Sondu (Lumbwa)	20
Samburu (Northern Frontier Province) ...	22,369
Isiolo (Northern Frontier Province) ...	1,156
Ngong (Masai)	449
Total ...	36,206

Conservation of stock from disease is not sufficiently comprehensive in dealing with native industrial stock development, particularly in pastoral areas, since although indegenous breeds are generally of good type and possess many desirable heritable factors, a condition of deterioration is invariably to be observed, and is unavoidable under existing native methods of animal husbandry.

In this connection an excerpt is appended from a report submitted on stock development, by Captain Mulligan :—

" Educational demonstration in an unobtrusive way is perhaps the best method of impressing the native mind, which is slow to adopt ideas foreign to tribal custom and usage. The economic aspect however appeals and although there may be no apparent interest, the native observes to an extent far beyond common belief.

The greatest deterrent factors, in my opinion, to the physical development and market value of native stock, are :—

(*a*) Inbreeding to an extreme extent.
(*b*) Breeding from the sexually immature.
(*c*) Breeding from the physically unfit.

(*a*) Inbreeding must always be regarded as harmful except when conducted under the most strict scientific conditions which necessitate the knowledge of existing favourable or undesirable heritable factors possessed by the male and female parents. Physical degeneration, sterility in degree are common sequelae of this practice, with loss of vigour and resistance to disease, debility and emaciation are consequent, direct or indirect, and general constitutional disturbance which reflects itself in the quality of the meat, hides and skins.

The introduction of unrelated blood through the male parent should not present very serious difficulty. The tribesmen might be encouraged through barazas and conversational intercourse, by demonstration at Veterinary stations, to realise and accept that breeding might be improved by the introduction of unrelated blood, and facilities could undoubtedly be afforded for the purchase or exchange of sires, from unrelated herds and flocks.

(*b*) Breeding from the sexually immature is scarcely less pernicious. Retrogression follows to an extent that requires generations of careful breeding to eliminate. The problem presents greater difficulties than inbreeding for the native mind is almost entirely concerned with quantity. This is, however, an economic fallacy, size, weight and quality are lost and the breeding period considerably curtailed. Demonstration is, I believe, the only possible method of educational instruction in this respect. Comparison between nondescript herds and flocks, and herds and flocks in which this influence is eliminated, might serve a useful purpose without undue pressure or the appearance of endeavouring to reorganise native methods.

(*c*) The sex ratio, i.e., the proportion of males to females born, for practically all the domestic animals is roughly 100 to 100. The prenatal an postnatal death rate is generally greater in males. When castration is not practised, at least to any definite extent, indiscriminate mating must occur, which means that reproduction is caused without any regard for hereditary physical defects, such as defective conformation, stunted growth, and lack of bone and all the other disabilities to be observed in all herds and flocks from native pastoral areas.

Castration should be encouraged of all defective males, for in addition to the sterilisation thus caused, there is a greater tendency to put on condition, and the flesh is of better quality.

Defective female stock should be marketed and thus not permitted to reproduce such defects to perpetuation. A good male parent cannot sire good progeny from a defective female parent, and the contrary is equally true.

It may be said that through a process of selective breeding on broad general lines with the elimination of the above three influences, types of stock of good marketable value could be evolved without the introduction of extraneous breeds.

At the same time experimental research into the breeding of size, quality of beef and mutton, milk supply, and the retention of adaptability to environmental conditions could be carried out at Veterinary stations, and results carefully recorded with a view to cautious distribution of bulls and rams should such results be considered satisfactory.

Thus it is that selective breeding, applied in its most elementary form, could in time improve the development of native stock almost out of recognition and if this object is kept in view and fostered whenever opportunity occurs, I feel sure the results will be reflected in material advancement.

Improvement in the quality of hides and skins would automatically proceed side by side with improvement of breeds, but flaying and the preparation of hides and skins for market involve a great field for industrial development. The enhanced value of shade-dried hides and skins is a sufficient inducement for the organisation of this industry, which should become in time a very flourishing one and of material benefit to the native. In this respect the Administration and Veterinary Department should co-operate to the fullest extent and endeavour to demonstrate the process and value along the lines demanded by market requirements."

The principles of selective breeding and animal management are easily applicable to native herds and flocks, and could be so demonstrated at the Veterinary stations which, as already mentioned, have been acquired in certain reserves, and which it is hoped may be acquired in all reserves.

The provision and distribution of good sires from native indigenous breeds would form an important and useful part of this work.

There is little interchange of native stock, except in connection with marriage agreements, and consequently inbreeding is an unfortunate result. Before the advent of European administration, tribal and intertribal warfare, raiding parties, and confiscation of stock, served a purpose in providing unrelated blood. Such methods of introduction no longer exist, but the requirements still remain.

A. G. DOHERTY,
Chief Veterinary Officer.

Nairobi,
March, 1929.

APPENDIX D.

ANNUAL REPORT OF THE CHIEF VETERINARY RESEARCH OFFICER, 1928.

I have the honour to submit the following Report upon the work of this Division for the above-mentioned period :—

(A) Administrative Activities.

Correspondence.

3,141 inward and 2,797 outward communications were dealt with during the year, a total of 5,938. This is excluding communications received and despatched in connection with slides and specimens submitted for diagnosis.

5,782 such slides and specimens were received and registered during the year, and reports on same typed and despatched.

A classification of these reports is shown further on under the heading " Technical Routine ".

Laboratory Farm.

Approximately 200 acres were under cultivation for the production of foodstuffs for laboratory animals, the main crop being green maize for ensilage. In addition to farming operations, the farm labour was employed throughout the year as follows : Maintenance and upkeep of roads, fences and grazing lands, quarrying stone for roads and concrete, preparation of ensilage, and the transport of fuel, foodstuffs and other stores from Kabete Railway Station.

The number of calves born of the special breeding stock maintained at the laboratory farm was :—

Grade bull calves	13
Grade heifer calves	34
Total ...	47

(B) Buildings and Plant.

Buildings.

The erection of five staff bungalows was sanctioned, and work on these commenced towards the end of the year. These bungalows are being erected by the Native Industrial Training Depot in conjunction with the Public Works Department.

The repair and maintenance of existing buildings was carried out by the Laboratory Workshops Staff.

Steam and Gas Plant.

In daily commission through the year, repairs where necessary, being effected by Workshops Staff. A new gasometer was erected ready for use.

Apparatus.

Existing apparatus was maintained in an efficient state by the Laboratory Mechanic and his staff. New items of apparatus installed included :—

New motor for wireworm remedy ball mill.
A large steam disinfector (Manlove Alliott's).
An electric centrifuge.

General.

Water Supply.

A shortage of water was again experienced during certain portions of the year.

A bore-hole some 200 feet in depth was put down near the Laboratory by the Public Works Department towards the end of the year.

This is estimated to yield 12,000 gallons per day, but is not yet in commission.

Workshops.

General work carried out under the supervision of the Laboratory Mechanic including repairs to transport vehicles, farm implements, etc., also the manufacture of serum and other packing cases, and various appliances for use in the Laboratory.

(c) Finance.

Expenditure.

The total sanctioned estimates for this Division for 1928 amounted to £33,803.

Savings to the extent of £3,471 were effected, making the actual expenditure for the year £30,322.

Revenue.

The direct sale of laboratory products during 1928 realised £10,830. Of this amount £8,940 was in respect of sales to other Governments. This does not include revenue accruing from sera and vaccines issued for inoculations by the field staff, such revenue being credited through the books of the Veterinary Division. The value of anti-rinderpest serum alone issued to the field staff during 1928 amounted to £21,360.

The total value of issues of laboratory products for which charges are gazetted amounted to £35,683. In addition, products to the value of £2,466 were manufactured and issued free of charge.

(D) LIVESTOCK.

The following statement shows the number of live stock, other than small animals and poultry, dealt with during the year :—

SPECIES	On Books 1-1-1928	Increases	Decreases	On Hand 31-12-1928
Horses	13	25	18	20
Mules	34	..	6	28
Donkeys	1	..	1	..
Cattle	807	739	836	710
Sheep	129	84	165	48
Goats	18	18	30	6
Pigs	14	22	16	20

Details of increases and decreases are as follows :—

Horses.

Increases.

Purchased for horse-sickness serum production ...	10
Received for experimental treatment and experiments into horse sickness	14
Born at laboratory	1
Total	25

Decreases.

Returned to owners after experimental treatment ...	6
Died	12
Total	18

Mules.

Decreases.

Died	6

Donkeys.

Decreases.

Returned to owner after experimental treatment ...	1

Cattle.

Increases.

Born at laboratory	78
Purchased for rinderpest serum production and experimental work	645
Received for experimental treatment, etc. ...	16
Total	739

Decreases. *Cattle.*

Deaths, including animals killed for rinderpest virus production and post-mortem examination ...	582
Returned to owners after experimental treatment ...	37
Transferred to Veterinary Training Depot, Ngong...	167
Issued to Veterinary Field Stations for rinderpest virus production	46
Sold for slaughter	4
Total	836

Increases. *Sheep.*

Born at laboratory	17
Purchased for experimental purposes and vaccine production	36
Received for experimental work and treatment ...	31
Total	84

Decreases.

Deaths, including animals killed for vaccine production and post-mortem examination	116
Returned to owners after experimental treatment ...	4
Surplus animals sold for slaughter	45
Total	165

Increases. *Goats.*

Born at laboratory	2
Purchased for experimental purposes	15
Received for experimental treatment	1
Total	18

Decreases.

Deaths, including animals slaughtered for post-mortem examination	30

Pigs.

Increases.

Born at laboratory	20
Received for experimental work	2
Total	22

Decreases.

Deaths, including animals slaughtered for post-mortem examination	16

In addition to above, 328 cattle were purchased at outstations by the field staff for rinderpest virus production. These animals were taken on charge by the officers concerned, but the cost of purchase—approximately £680—was met from our "Purchase of Animals" Vote.

As in 1927, a number of Rhode Island Red cocks were sent to the laboratory for immunisation against fowl typhoid (Kikuyu fowl disease) and fowl pox, prior to issue to Native Reserves. The total number of birds so dealt with during 1928 was 227.

Technical Routine.

The number of slides and specimens submitted for diagnosis totalled 5,782.

These comprised :—

Bovines	5,336
Equines—Horses	100
,, —Mules	33
,, —Donkeys	12
Ovines	69
Caprines	4
Porcines	34
Avians—Fowls	93
,, —Turkeys	31
,, —Ducks	5
Various	14
Canines	51
Total ...	5,782

The classification of the diagnosis arrived at is as follows :—

Bovines ... ... Total examined	5,336
Anaplasmosis	225
Anaplasmosis (suspicious)	2
Anisosytosis	26
Anthrax	52
Ascaris	1
Blackquarter	7
Broncho-pneumonia	6
Contagious abortion	47
Contagious abortion (doubtful and suspicious)	11
Colon bacillosis	17
East Coast fever	923
East Coast fever (doubtful and suspicious)	28
Echinococcus cysts	2
Fluke (distoma)	1

Heartwater		8
Pleuro-pneumonia		9
Paratyphoid		10
Redwater		327
Rinderpest		4
Small piroplasms		362
Streptothricosis		5
Trypanosomiasis		25
Unsuitable for examination		206
Negative		3,032
EQUINES (Horses)	Total examined	100
Ulcerative lymphangitis		37
Ulcerative lymphangitis (suspicious)		1
Epizootic lymphangitis		3
Streptothricosis		2
Pneumonia		1
Biliary fever		1
Unsuitable for examination		4
Negative		51
EQUINES (Mules)	Total examined	33
Ulcerative lymphangitis		7
Epizootic lymphantitis		8
Negative		18
EQUINES (Donkeys)	Total examined	12
Negative		12
OVINES	Total examined	69
Bacillus necrosis		2
Fluke (distoma)		2
Hookworm		4
Heartwater		1
Heartwater (suspicious)		9
Laikipia lung disease		3
Pneumonia		2
Wireworm		5
Unsuitable for examination		6
Negative		35
CAPRINES	Total examined	4
Negative		4
PORCINES	Total examined	34
Anthrax		4
Cysticercus cellulosae		1
Swine fever		3
Swine fever (suspicious)		3
Trypanosomiasis		4
Pneumonia		1
Unsuitable for examination		6
Negative		12

Canines	Total examined	51
Arsenical poisoning	3	
Anaemia	3	
Tick fever (pirop. canis)	18	
Trypanosomiasis	2	
Unsuitable for examination	3	
Tumour (adeno. carcinoma malignant) ...	1	
Negative	21	
Avians (Fowls)	Total examined	93
Ascaris	3	
Chicken pox	5	
Fowl typhoid (Kikuyu fowl disease) ...	36	
Peritonitis	5	
Roup	3	
Rupture of egg sac	2	
Retained egg	4	
Sarcoma of liver	3	
Tumour of liver	2	
Unsuitable for examination	9	
Negative	21	
Avians (Turkeys)	Total examined	31
Aspergillosis	1	
Chicken pox	4	
Fowl typhoid (Kikuyu fowl disease) ...	9	
Peritonitis	2	
Negative	15	
Avians (Ducks)	Total examined	5
Unsuitable for examination	2	
Negative	3	
Zebra	Total examined	1
Streptothricosis	1	
Bush Buck	Total examined	2
Negative	2	
Kongoni	Total examined	1
Negative	1	
Guinea Fowls	Total examined	2
Tapeworm	2	
Chimpanzee	Total examined	1
Negative	1	
Ticks	Total examined	3
Margaropus australis (blue tick) ...	1	
Rhip. appendiculatus	2	
Flies	Total examined	2
Glossina papalis	2	
Worms	Total examined	1
Ascaris megalocephala	1	
Plants	Total examined	1
Non-poisonous	1	

PREPARATIONS OF LABORATORY PRODUCTS FOR THE YEAR ENDED 31ST DECEMBER, 1928.

PRODUCTS	Balance on hand 31–12–1927	Prepared by the Laboratory during the year	Returned to the Laboratory	Issued during the year	Written off as too old for issue	Balance on hand 31–12 1928
Anti-Rinderpest Serum	13,561,500	7,254,000	333,800	17,297,250	192,800	3,659,250 c.c.
Anthrax Vaccine 1st	Nil	15,896	700	15,896	700	Nil doses
,, ,, 2nd	,,	16,071	..	16,071	..	,, ,,
Blackquarter Vaccine 1st	330	..	50	..	380	,, ,,
,, ,, 2nd	342	..	50	..	392	,, ,,
,, ,, Liquid	Nil	30,102	..	30,102	..	,, ,,
Bluetongue Vaccine	14,348	..	..	30	..	14,318 ,,
Colon Bacillosis Vaccine	718	4,240	5	4,419	130	414 ,,
Contagious Abortion	Nil	686	..	686	..	Nil ,,
Kikuyu Fowl Disease Vaccine	,,	14,424	..	14,424	..	,, ,,
Laikipia Lung Disease Vaccine	,,	20,375	..	20,375	..	,, ,,
Pleuro-pneumonia Vaccine	,,	284,345	..	284,345	..	,, ,,
Paratyphoid Serum	,,	160	..	160	..	,, ,,
,, Vaccine	,,	2,084	..	2,084	..	,, ,,
Redwater and Anaplasmosis Vaccine	,,	285	..	285	..	,, ,,
Sheep-pox Vaccine	,,	1,000	..	1,000	..	,, ,,
Trypanblue Bovine	35	812	..	659	..	188 ,,
,, Canine	58	311	..	275	..	94 ,,
Ulcerative Lymphangitis	5	21	..	26	..	Nil courses
Wireworm Remedy Powder	100,600	687,800	..	679,200	..	109,200 doses
Chicken-pox Vaccine	Nil	1,803	..	1,803	..	Nil ,,
Horse Sickness Serum	,,	25,700	..	3,200	..	22,500 c.c.

DETAILS OF ISSUES OF LABORATORY PRODUCTS, 1928.

Products	Issued to Department Officers	Issued to Stock Owners	Other Countries	Used in Laboratory Experiments	Total Issues for 1923
Anti-Rinderpest Serum	10,680,000	343,500	6,260,000	13,750	17,297.250 c.c.
Anthrax Vaccine 1st	11,319	4,577	..	..	15,896 doses
,, ,, 2nd	11,419	4,652	..	..	16,071 ,,
Blackquarter Vaccine 1st	..	..	..	..	Nil ,,
,, ,, 2nd	..	..	..	..	,, ,,
,, ,, Liquid	6,472	22,430	1,200	..	30,102 ,,
Bluetongue Vaccine	..	30	..	..	30 ,,
Colon Bacillosis Vaccine	110	4,309	..	..	4,419 ,,
Contagious Abortion Vaccine	54	632	..	..	686 ,,
Kikuyu Fowl Disease Vaccine	900	13,524	..	..	14,424 ,,
Laikipia Lung Disease Vaccine	300	20,075	..	..	20,375 ,,
Pleuro-pneumonia Vaccine	229,903	54,222	220	..	284,345 ,,
Paratyphoid Serum	..	160	..	..	160 ,,
,, Vaccine	..	1,884	200	..	2,084 ,,
Redwater and Anaplasmosis Vaccine	156	129	..	..	285 ,,
Sheep-pox Vaccine	..	1,000	..	..	1,000 ,,
Trypanblue Bovine	399	260	..	..	659 ,,
,, Canine	229	46	..	..	275 ,,
Ulcerative Lymphangitis Vaccine	13	13	..	..	26 courses
Wireworm Remedy Powder	40,000	632,600	6,600	..	679,200 doses
Chicken-pox Vaccine	..	1,803	..	..	1,803 ,,
Horse Sickness Serum	..	..	..	3,200	3,200 c.c.

RESEARCH.

Owing to the absence on vacation and "extension for study" leave of two research officers during the greater part of the year, the vast amount of technical routine work, including examination of smears and specimens, technical correspondence, supervision of the preparation of laboratory products, etc., devolved on the two remaining officers, and the programme of research work had consequently to be curtailed.

A.—RINDERPEST.

(1) The Supply of "Clean" Virus Makers (Cattle Susceptible to Redwater and Gallsickness).

The breeding and rearing at Kabete of "clean" virus makers was commenced; calves the progeny of the Laboratory breeding herd are kept housed in a tick-free building with their mothers from birth; when the calves are of a suitable age for weaning the mothers are returned to the breeding herd and the calves remain in the tick-free stalls. As a temporary measure, until the latter reach an age suitable for producing rinderpest virus, a number of young cattle age about 15 months, purchased from an estate where three days dipping is regularly carried out from or shortly after birth, are being utilised for virus makers; it having been previously determined that the blood of a percentage of the young cattle reared on the estate does not produce redwater or gallsickness. On arrival at the Laboratory the virus makers are dipped and hand dressed and housed in a tick-free stable isolated from rinderpest, put on daily temperature, blood smears collected at intervals and examined, and blood of these which show no parasites inoculated to newly born calves which are kept housed in a tick-free building with their mothers from birth; the calves are put on daily temperature, smears collected daily and examined; the virus makers are kept on temperature, and their blood examined at intervals. The calves are kept under observation for approximately 40 to 50 days, which covers the incubative period of anaplasmosis from inoculation. In the event of the smear examination being negative for redwater and gallsickness, the virus makers remain under observation and under tick-free conditions, and when blood is required for the immunisation of dipped cattle, one or more of the tested animals is subcutaneously inoculated with nasal secretion of a rinderpest reacting beast and forwarded by rail to the Veterinary Officer who is carrying out the rinderpest immunisation operations.

Some susceptible newly born calves, reared on their mothers, do not definitely react to either redwater or gallsickness, and in such cases parasites do not occur in the peripheral circulation, or are rare and may escape detection; hence the method of determining whether a selected virus

maker is susceptible or otherwise to redwater and gallsickness by inoculation of a few c.c. of its blood to a newly born calf is not infallible.

Twenty-nine tested virus makers infected with nasal secretion of a rinderpest-reacting beast have been issued for the production of virus for the immunisation of many thousand head of dipped cattle; in one instance blood of the virus maker was in all probability responsible for the transmission of anaplasmosis.

Testing the blood of virus makers on newly born calves has been of assistance in avoiding losses from redwater and gallsickness in dipped cattle.

(2) The Substitution of Rinderpest Blood kept at a Low Temperature (0° C.) for Fresh Virulent Blood.

In view of the difficulty experienced by Veterinary Field Officers in obtaining supplies of virulent blood owing to various causes, *e.g.*, non-susceptibility of some of the selected virus makers, etc., the delay which occurs in consequence, the impracticability of selecting in the field virus makers susceptible to redwater and gallsickness for the immunisation of regularly dipped cattle, and the economy which would be effected in the production of virus, it was considered that the laboratory should arrange for the preparation and issue of all rinderpest virus required in the field.

Hitherto, virulent blood, kept at atmospheric temperature, was used up till 18-24 hours after the hour of bleeding, but owing to a percentage of cattle inoculated with 12-18 hours' old blood and anti-serum failing to react or acquire immunity, the use of other than fresh blood was discontinued except when the blood could be used within 4-6 hours of the hour of bleeding, in which case it is issued packed on ice in insulated boxes; if the blood cannot be used within 4-6 hours, a virus maker is infected at the Laboratory and railed to a centre where the animal is bled when reacting and the freshly bled blood used.

Rinderpest blood kept at low temperatures, *viz.*, 0° C., remains virulent for a longer period than blood kept at ordinary room temperature; there is little reference in the literature as to the efficacy or otherwise of blood kept at low temperatures for rinderpest immunisation (simultaneous method), but in some countries—Egypt—blood packed on ice is used in the field for rinderpest immunisation (simultaneous method).

During 1927-1928 a few head of grade cattle were put on experiment to determine whether the inoculation of blood kept at 0° C. for 72 and 30 hours and simultaneously anti-serum would produce a reaction and confer immunity.

ACCOMMODATION PROVIDED FOR REARING RINDERPEST VIRUS MAKERS FREE FROM TICKBORNE DISEASES

STAFF AND PUPILS AT THE VETERINARY TRAINING DEPOT, NGONG.

Summary of Results.

(1) The simultaneous inoculation of blood kept for 72 hours at 0° C. and anti-serum at the rate of 30 and 45 c.c. per 220 lb. body weight, dose of anti-serum 60 and 90 c.c., produced rinderpest (two in experiment).

(2) The simultaneous inoculation of blood kept for 30 hours at 0° C. and anti-serum at the rate of 15, 20 and 30 c.c. per 220 lb. body weight, dose of anti-serum varied from 31 to 60 c.c., produced rinderpest. In one instance the reaction was delayed, commencing on the 7th day (six in experiment).

Several hundred doses of blood kept at 0° C. have been issued for field inoculations and used within twenty-four hours of the hour of bleeding, with apparently satisfactory results.

During 1928, virus makers susceptible to redwater and gallsickness were urgently required for the immunisation of a large number of dipped cattle. Owing to the limited number of clean virus makers, it was decided to infect those available with nasal secretion of a rinderpest-reacting beast at the laboratory, bleed the animals when reacting and issue the virulent blood packed on ice for use up to within twenty-four hours after the hour of bleeding.

Method of keeping the blood at 0° C.

The virus makers were bled during the temperature reaction to rinderpest, the blood collected in 250 c.c. bottles in equal parts of sodium citrate solution; the bottles were then placed in a metal holder, which is fitted in a metal-lined compartment in which the ice is packed.

The box itself is made of teak, the top, bottom and sides being insulated with cork; the blood packed in this way remains at a temperature of 0° C. for at least forty-eight hours.

Rinderpest blood on ice was also used for the immunisation (simultaneous method) of several thousand cattle on five estates under the supervision of the Veterinary Officer of the district (Captain Creery), who has recorded his observations on the results. The cattle consisted of grades and native, other than calves; although rinderpest reactions were observed, and some mortality from rinderpest occurred amongst the inoculated cattle on each of the estates, it was decided to test the cattle some weeks later on their immunity with fresh virulent blood. On one estate, 6.6 per cent. of the number put on temperature for the immunity test reacted to rinderpest; on two, the animals were found immune; no immunity test was carried out on another, and on the remaining estate cases of rinderpest occurred from September onwards amongst the lot of cattle double-inoculated in July; this lot consisted of cows in calf. The dose of serum simultaneously injected was large, *viz.*, 200 c.c. per animal.

In view of the above results, investigations into the simultaneous inoculation of blood kept at 0° C. and smaller doses of anti-serum were planned for, and it is hoped to carry these out in the field at an early date.

(3) Inoculation of 24 and 36 hours old Rinderpest Blood kept at a Temperature of 0° C. and 24 hours later Anti-serum.

An experiment was carried out to ascertain whether inoculation of 24 and 36 hours old blood respectively, kept at 0° C., and, 24 hours later, anti-serum at varying rates, *viz.*, 20-50 c.c. per 100 kilos body weight—dose of serum varied from 10-60 c.c.—would produce a reaction and confer immunity.

Experiment 1991, 17/10/28.

A total of 26 head of weaned grade heifers, in rather poor condition, the progeny of the Laboratory breeding herd, varying in age up to approximately twelve months, were utilised in the experiment. The majority were susceptible to redwater; the blood used for inoculation was obtained from a recovered redwater-gallsickness beast. Owing to the scarcity of grazing the cattle were hand fed; immunisation was carried out during the rainy season, but the animals had access to a shed. The experiment was thus carried out under not too favourable conditions.

Summary.

All, with the exception of one animal which did not react to inoculation or immunity test and was apparently immune prior to inoculation, reacted to the simultaneous inoculation of blood kept at 0° C. for 24 and 36 hours respectively and varying rates of anti-serum. The mortality from rinderpest, complicated in two cases with redwater, amounted to 12 per cent. Thirteen of the animals also reacted to redwater. The survivors were tested on their immunity on the 17th day, with 2 c.c. fresh virulent blood, and proved to be immune.

Conclusions.

Blood kept at 0° C. for 24 and 36 hours, and inoculated 24 hours before the anti-serum, transmits rinderpest and confers immunity, but cattle of varying susceptibility should be inoculated under field conditions under veterinary supervision to obtain data as to the mortality which occurs in such under field conditions.

(4) The Substitution of Nasal Secretion of a Rinderpest Reacting Beast for Virulent Rinderpest Blood.

Nasal secretion was frequently used for infecting virus makers susceptible to redwater and gallsickness and occasionally for the immunisation (simultaneous method) of imported cattle susceptible to redwater and gallsickness.

Nasal secretion free of red cells is collected from a rinderpest beast by rubbing the mucosa with cotton wool and inserting the cotton wool in 100 c.c. normal citrate solution, this being repeated two or three times. 5 c.c. of the infected citrate solution is inoculated subcutaneously on each side of the flank.

In two of the virus makers a yellow gelatinous infiltration of the subcutaneous tissues occurred at the seat of inoculation and gradually extended, resulting in the death of the animals. Microscopical examination of the exudate showed various organisms. This condition has not been observed in cattle inoculated with nasal secretion collected on the first or second day of the temperature reaction, but in both the above-mentioned cases occurred after subcutaneous inoculation of secretion collected from cattle on the 5th-6th day of the rinderpest temperature reaction.

(5) Observations on the Immunisation (Simultaneous Method) of Imported Cattle.

Several lots of imported cattle were sent to the Laboratory for rinderpest immunisation; high index doses of anti-serum were used with a view to preventing severe reactions.

Lot 1 consisted of five imported South African bulls, ages 2-3 years; they were laboratory numbered 1-5. As the animals were in all probability susceptible to redwater and anaplasmosis, and rinderpest bovine blood free of these infections was not available, nasal secretion of a reacting rinderpest beast and, in one instance, goat virus, was substituted for virulent bovine blood.

Summary.

Four susceptible imported bulls were inoculated with fresh citrated nasal secretion, and one with fresh blood of a goat reacting to inoculation of virulent bovine blood, and simultaneously a high index dose of anti-serum, *viz.*, 48, 60, 67, 74 and 80 c.c., respectively per 100 kilos body weight; dose of anti-serum varied from 250-300 c.c.; each gave a definite temperature reaction to rinderpest, commencing on the 5th day, and when reacting each got subcutaneously 250 c.c. of anti-serum. None of the animals was visibly sick during the temperature reaction.

Four were tested on their immunity on the 15th day after the date of inoculation, and one on the 13th day with fresh nasal virus; three again reacted but were not visibly sick.

Lot 2 consisted of three imported bulls, ages 3-4 years, laboratory numbered 6, 7 and 8.

History of the bulls.

Since arrival in the Colony they were immunised against redwater and anaplasmosis and subsequently used for stud purposes on an estate on which an outbreak of rinderpest occurred after their arrival. When the disease existed they were isolated and kept under serum, and, according to the manager, did not contract rinderpest. They were subsequently sent to the Laboratory for rinderpest immunisation.

Summary.

Three imported bulls were inoculated each with blood kept at 5° C. for 20 hours and anti-serum at the rate of 75 c.c. per 100 kilos body weight. Dose of anti-serum amount to 429, 360 and 450 c.c. respectively. No. 7 reacted from the 5th-10th day, maximum temperature 105° F., and was off feed for one day when reacting. This beast was tested on its immunity, with 5 c.c. fresh virulent blood, on the 19th day, but did not react. The remaining two bulls, Nos. 6 and 8, did not react to the original simultaneous inoculation or to simultaneous re-inoculation, 8 days later, with fresh virulent blood and anti-serum at the rate of 30 c.c. per 220 lb. body weight. Nos. 6 and 8 were again inoculated 11 days after the date of the second simultaneous inoculation with fresh virulent blood and anti-serum at the rate of 20 c.c. per 100 kilos body weight.

Result.

No. 6 gave a slight temperature reaction and was injected during the reaction with 115 c.c. of anti-serum; it was not visibly sick. No. 6 was tested on its immunity with fresh virulent blood on the 7th and 14th days respectively, after the date of the third simultaneous inoculation, but proved to be immune.

No. 8 also gave a slight temperature reaction to the third simultaneous inoculation and was subsequently tested on its immunity with fresh virulent blood and showed a slight temperature reaction.

Lot 3 consisted of 3 imported bulls, ages approximately two years, recently recovered from redwater and anaplasmosis immunisation. Laboratory numbers of the bulls were 9, 10 and 11.

Summary.

Three bulls were inoculated with anti-serum at the rate of 45 c.c. per 100 kilos—dose of anti-serum varied from 142 to 172 c.c.—and simultaneously with fresh virulent blood.

Result.

The temperature of No. 10 was irregular from the second day. Blood smears of this beast showed *P. bigeminum* parasites daily. Nos. 9 and 11 did not react.

On the eighth day after the date of the simultaneous inoculation the three bulls were re-inoculated with fresh virulent blood and anti-serum at the rate of 20 c.c. per 100 kilos.

No. 9 reacted from the fourth to tenth day, maximum 105° F. 6th day, but was not visibly sick. Nos. 10 and 11 reacted from the 5th and 2nd days respectively; both died of rinderpest complicated with a recurrence of redwater parasites. Blood was collected from No. 11 on the 5th day after the date of re-inoculation and produced rinderpest.

No. 9 was not tested on its immunity.

Lot 4.—In addition to the above a further lot of South African bulls, age about two years, were sent to the Laboratory in January, 1929, for rinderpest immunisation. They were Laboratory numbered 3333 and 3334.

On 14/1/29 they were inoculated with fresh nasal virus and simultaneously anti-serum at the rate of 45 and 60 c.c. respectively per 100 kilos body weight; dose of anti-serum 250 c.c. 3333 and 3334 gave an irregular temperature reaction from the 7th to 9th day, maximum 103.8° and 103° F. respectively, but were not visibly sick. Blood was collected from 3334 on the 7th day and inoculated to a susceptible beast, but it did not transmit rinderpest.

The two bulls were re-inoculated with nasal virus and simultaneously anti-serum at the rate of 25 c.c. per 100 kilos body weight—dose of anti-serum, 137 and 100 c.c. respectively—on the 9th day after the date of the original simultaneous inoculation.

Result.

Both reacted to rinderpest, 3333 from the 4th and 3334 from the 5th day.

Conclusions.

1. Simultaneous inoculation of nasal virus and a high index dose of anti-serum (250 c.c.) produces in some highly susceptible cattle (Lot 1) a temperature reaction to rinderpest; treatment of reacting animals approximately 24 hours after the rise of temperature with a large dose of anti-serum appears to be of assistance in controlling the reaction.

2. Other highly susceptible cattle (Lot 4) fail to react to simultaneous inoculation of nasal virus and a high index dose of anti-serum, 250 c.c. (blood collected from one of the inoculated bulls on the 7th day did not transmit rinderpest), but may react to simultaneous re-inoculation of nasal virus and a smaller index dose of anti-serum (25 c.c. per 100 kilos).

3. Judging from the temperature reaction which occurred in some of the animals of Lot 1 when subsequently tested on their immunity with nasal virus, immunity was not complete in three of the animals.

4. The failure of highly susceptible cattle (Lot 4) to react to the original inoculation of fresh nasal and anti-serum may be due to the large index dose of anti-serum or to nasal virus being less virulent than fresh virulent blood, or to both.

The experience is that fresh nasal virus alone does not fail to produce rinderpest in susceptible cattle, but there is little data available as to the efficacy of nasal virus when inoculated simultaneously with large doses of anti-serum.

5. Simultaneous inoculation of 20 hours old blood kept at 5° C. and a high index dose of anti-serum fails to produce a reaction in some highly susceptible imported cattle, presumably susceptible to rinderpest (Lot 2), and judging from the temperature reaction which occurred on simultaneous re-inoculation or in immunity tests with fresh virulent blood the animals which failed to react were not completely immune.

6. The failure of three bulls (Lot 3) to react to the original simultaneous inoculation of fresh virulent blood and anti-serum at the rate of 45 c.c. per 100 kilos is at present unexplainable, the experience being that highly susceptible cattle *invariably* react to simultaneous inoculation of fresh virulent blood and an index dose of 45 c.c. per 100 kilos body weight.

7. With the exception of the two bulls of Lot 3, which reacted severely and died, the reaction being complicated with a recurrence of redwater and anaplasma parasites, none of the remaining animals inoculated with fresh virulent blood or fresh nasal virus and simultaneously a large dose of anti-serum reacted severely to rinderpest, but it is doubtful whether complete immunity was conferred in such. Animals which do not react to simultaneous inoculation of large doses of anti-serum and fresh virulent blood or fresh nasal virus should not be considered immune, but should be re-inoculated, and animals which react mildly to simultaneous inoculation should be tested on their immunity with fresh virulent blood or fresh nasal virus.

8. Immunisation of highly susceptible imported cattle recently recovered from redwater and anaplasmosis immunisation is not recommended owing to the risk of recurrences of both infections.

(6) Rinderpest Vaccine.

Cattle were put in experiment to determine the immunity conferred by inoculation of :—

1. Toluol spleen extract of a recovered virus maker.
2. Toluol spleen extract of a hyperimmunised beast.
3. Toluol spleen extract of a reacting virus maker.
4. Chloroform spleen extract of a virus maker.
5. Chloroform extract of spleen, liver and lymph glands (equal parts) of a reacting virus maker.
6. Formalin extract of spleen, liver and lymph glands (equal parts) of a reacting virus maker.

1. Toluol Spleen Extract of a Recovered Virus Maker.

(*a*) *Two inoculations at an interval of seven days.*

The spleen was collected from bovine No. 1693. This animal was inoculated on 7/9/28 with virulent blood and reacted to rinderpest, and was bled for virus for hyperimmunising purposes, and eventually recovered. 1693 was slaughtered on 8/11/28 and the spleen put through a Latapie pulper, the pulp mixed with normal saline in the proportion of 1 of pulp to 4 of saline and toluol added to make one per cent. of the total bulk. The pulp was then passed through muslin and incubated at 38° C. for 96 hours.

Cattle Nos. 3068, 3069 and 3070, ages approximately 15 months, were inoculated on 11/11/28 with 20, 40 and 60 c.c. respectively, and 7 days later with a similar dose. Although they were kept in a separate stable, one of the animals, 3069, contracted rinderpest by contact through native attendants; the remaining two were left in contact.

Results.

C 3069 contracted rinderpest by contact. The temperature reaction commenced on 23/12/28; the animal died of rinderpest on the 19th day.

C 3086 reacted to contact infection from 31/12/28 and died of rinderpest on the 15th day.

C 3070 reacted to contact infection from 29/12/28 and died of rinderpest on the 11th day.

(*b*) *Toluol spleen extract of a recovered virus maker and simultaneously 2 c.c. fresh citrated blood.*

Spleen extract of C 1693 (see above) was inoculated to three cattle, Nos. 2980, 2982 and 3067, ages approximately 15 months; dose, 20, 40 and 60 c.c. respectively and simultaneously 2 c.c. fresh citrated virulent blood.

All three cattle reacted severely to rinderpest, but recovered.

2. Toluol Spleen Extract of a Hyperimmunised Beast.

The spleen was collected from serum maker No. 2744. No. 2744 was put in testing potency of serum experiment on 8/8/28 and hyperimmunised on 15/11/28 for serum making; bled for serum and slaughtered on 17/12/28.

The spleen was treated as above and incubated for 120 hours at 38° C. Cattle Nos. 3312, 3319 and 3320, susceptible to redwater, ages approximately 15 months, were put in experiment. 3312 was inoculated three times at intervals of 7 days with 20 c.c.; total dose, 60 c.c.

3319 was inoculated three times at intervals of 7 days with 40 c.c.; total dose, 120 c.c.

3320 was inoculated twice at an interval of 7 days with 60 c.c.; total dose, 120 c.c.

Immunity test.

3320 was tested on its immunity 12 days after the date of the last inoculation, 3312 and 3319 eleven days after the date of the third inoculation, each with 2 c.c. citrated fresh virulent blood.

Result.

3312 and 3319 did not react; 3320 reacted and recovered. 3320 also reacted to *P. bigeminum* infection, which was transmitted by the blood used for the immunity test.

3. Toluol Spleen Extract of a Reacting Virus Maker.

(*a*) *Two and three inoculations at intervals of seven days.*

Spleen of a reacting virus maker was pulped on 21/12/28 and mixed with saline, 4 of saline to 1 of pulp, and toluol added to make one per cent. of the total bulk, and incubated for 72 hours at 38° C., and then inoculated.

3315 and 3316 were inoculated three times at intervals of 7 days with 40 and 60 c.c. respectively; total quantity injected, 120 and 180 c.c. 3322 and 3326 were inoculated twice at 7 days' interval with 80 and 100 c.c.; total quantity injected, 160 and 200 c.c. The four cattle were susceptible to redwater. The spleen pulp did not transmit redwater.

Immunity test.

3315 put in contact with infected animals on the 11th day after the date of the last injection.

3316 inoculated with 2 c.c. fresh virulent blood on the 11th day after the date of the last injection.

3322 inoculated with 2 c.c. fresh virulent blood on the 16th day and 3326 on the 10th day after the date of the last injection.

Result.

3315, slight temperature reaction from the 6th day; blood collected during the reaction did not produce rinderpest.

3316, no reaction.

3322, no reaction.

3326, slight temperature reaction on the 6th and 7th days, maximum 102° F.

(*b*) *Toluol extract of spleen of a reacting virus maker and simultaneously 2 c.c. fresh virulent blood.*

The spleen was pulped on 6/12/28 in a Latapie, saline in the proportion of 4 of saline to 1 of pulp and toluol to make 1 per cent. of the total bulk added, and the treated pulp incubated for 96 hours at 38° C.

C 3064, 3066 and 3071 were inoculated on 10/12/28 with 20, 40 and 60 c.c. respectively of the extract and simultaneously with fresh virulent blood.

Result.

All three reacted, 3064 and 3071 recovered, and 3066 died of rinderpest.

4. Chloroform Spleen Extract of a Virus Maker.

Virus maker No. 3201 was bled to death on 24/12/28 when temperature had dropped to normal, and the spleen collected and minced through the Latapie pulper, pulp filtered through muslin, and equal parts of normal saline added. Chloroform was then added at the rate of 0.75 c.c. per 100 c.c., and the extract kept in the ice chest at 5° C.

Bovine 3313 was inoculated on 28/12/28 with 20 c.c. of the extract and 7 days later with a similar dose.

Result.

Slight rise of temperature from the 3rd to 5th day, maximum 102.6° F.

Immunity test.

16/1/29, subcutaneously, 2 c.c. fresh citrated virulent blood.

Result.

Marked temperature reaction to rinderpest and reaction to redwater. Animal recovered.

Bovine 3318, inoculated on 28/12/28 with 40 c.c. of the extract.

Result.

Slight rise of temperature from the 3rd day, normal on the 6th day. Maximum 103° F.

Immunity test.

15/1/29, subcutaneously, 2 c.c. fresh citrated virulent blood.

Result.

Marked temperature reaction to rinderpest and reaction to redwater. Animal recovered.

Bovine 3324, inoculated on 28/12/28 with 60 c.c. of the extract.

Result.

No reaction.

Immunity test.

16/1/29, subcutaneously, 2 c.c. fresh citrated virulent blood.

Result.

Marked temperature reaction to rinderpest, animal also reacted to redwater. Animal recovered.

5. Chloroform Extract of Spleen, Liver and Lymph Glands (equal parts) of a Reacting Virus Maker.

A mixture of the above, equal parts, after pulping on 19/4/28 was mixed with equal parts of normal saline and chloroform added to the bulk to make a concentration of 0.75 per cent., and stored in the ice chest at 5° C.

Bovine 2812 was inoculated subcutaneously on 24/4/28 with 20 c.c. of the extract, and 8 days later with a similar dose and 2813 on 24/4/28 with 20 c.c. of the extract.

Result.

No reaction.

Immunity test.

22/8/28, subcutaneously, 2 c.c. fresh citrated virulent blood.

Result.

Both reacted to rinderpest and redwater; 2813 died of rinderpest on the 11th day; 2812 survived.

6. Formalin Extract of Spleen and Intestines (equal parts) of a Reacting Virus Maker.

Equal parts of spleen and intestines pulped on 1/12/27 and one part of pulp to 4 of saline and commercial formalin to make one per cent of the total bulk added; incubated 72 hours at 38° C. and then kept at room temperature for approximately five months in the dark in a flask plugged with cotton wool.

Bovines 2819 and 2822 inoculated subcutaneously on 24/4/28 each with 40 c.c. of the extract.

Result.

No reaction.

Immunity test.

22/8/28, subcutaneously, 2 c.c. citrated virulent blood

Result.

Both reacted. 2819 died of rinderpest on the 11th day; 2822 recovered.

Summary of Results.

1. (*a*) Two inoculations at 7 days' interval of toluol spleen extract of a *recovered* virus maker did not protect against contact infection (3 in experiment).

(*b*) Toluol spleen extract of a recovered virus maker did not protect against simultaneous inoculation of virulent blood.

2. Three inoculations, at intervals of 7 days, of toluol spleen extract of a *hyperimmunised* serum maker protected against 2 c.c. of fresh citrated virulent blood (2 in experiment). The same quantity which completely protected at 3 inoculations did not completely protect at 2 inoculations (1 in experiment).

3. (*a*) Three inoculations, at intervals of 7 days, of toluol spleen extract of a *reacting* virus maker protected (2 in experiment. Two inoculations, at an interval of 7 days, of large doses protected (2 in experiment).

(*b*) Toluol spleen extract of a reacting virus maker did not protect against simultaneous inoculation of fresh citrated virulent blood (3 in experiment).

4. Chloroform spleen extract of a virus maker (spleen collected on the day temperature had dropped to normal), one and two inoculations, did not protect (3 in experiment).

5. Two cattle inoculated with chloroform extract of a mixture of spleen, liver and lymph glands of a *reacting* virus maker were tested on their immunity 120 days later with fresh citrated virulent blood, and proved to be non-immune.

6. Two cattle inoculated with formalin extract of equal parts of spleen and intestines, stored for approximately 5 months, of a reacting virus maker, proved to be susceptible when tested on their immunity 120 days later with 2 c.c. fresh citrated virulent blood. The same extract when used shortly after preparation conferred some resistance against simultaneous contact infection (3 in experiment). (See Annual Report of the Department of Agriculture for 1927, page 129.) The three cattle were tested on their immunity on 30/3/28 with 2 c.c. citrated virulent blood and were resistant.

7. Toluol or chloroform treated spleen of a recovered redwater-gallsickness beast was non-virulent for redwater; observations were not made on the virus of gallsickness (anaplasmosis).

Conclusions.

1. Comparing the resistance conferred by toluol extract of spleen, liver, intestines and muscle of a *reacting* virus maker, three inoculations of the former at 7 days' interval has so far given the most promising results.

2. The resistance to subcutaneous inoculation of fresh citrated virulent blood several days after the last inoculation varies; in some animals it is complete, in others partial. Some of the animals, which were completely resistant, when re-tested on their immunity some weeks later possessed only a partial resistance.

3. A given large quantity of spleen extract (120 c.c.) completely protects some animals, but only partially protects others.

4. Spleen extracts vary in potency; a number of treated spleens of a reacting virus maker should be pooled and stored in cold storage and the potency of the pooled extract determined by inoculation of highly susceptible cattle, two or three inoculations respectively, at 7 days' interval, with varying doses, and the animals tested on their immunity with a dose of fresh virulent blood 7-14 days after the date of the last inoculation.

5. Spleen extract of a recovered virus maker would appear to possess no protective properties.

During the months of December, 1927, and January, 1928, field inoculations were carried out by the Assistant Chief Veterinary Research Officer with prophylactic vaccines. The types of vaccine used were the outcome of laboratory experiments performed during 1927, and which are reported in a paper published in 1928 in the *Journal of Comparative Pathology and Therapeutics*. A type of mildly infective vaccine was used in the first instance and this, although apparently quite safe for use in the laboratory, gave rise to rinderpest when inoculated in the field. Of 114 animals inoculated with this type of vaccine at Ngong, 105 showed temperature reactions during the period from the 5th to the 9th day. Cases of clinical rinderpest developed and, in spite of treatment with serum, 21 animals died.

In the course of another field inoculation with this type of vaccine, 108 animals reacted out of 127 inoculated, and there were 4 cases of mild clinical rinderpest. In-contact susceptible animals also developed mild rinderpest, and of 43

susceptible animals which were in contact for a period of one month, one died, possibly as the result of being vaccinated while in the incubative stage of the disease. No fatalities occurred among the original inoculated mob of 127. Further vaccinations that were carried out on this farm included the inoculation of 62 yearlings and 17 pregnant cattle with a non-infective vaccine, without the production of any reactions. This vaccine was of the type used upon 20 pregnant animals in the Ngong inoculation without any apparent harmful effects. 169 animals were also inoculated with the non-infective vaccine which was followed seven days later by a similar dose of the infective vaccine, and of these only 4 showed mild temperature reactions as a result of the second inoculation; this is in striking contrast to the percentage of reactions produced by this infective vaccine in the previous lots of inoculated animals. The animals inoculated at Ngong will be re-inoculated by the serum-simultaneous method during January, 1929, thirteen months after vaccination. A careful record of temperature reactions will be kept. A sample has been drawn of the animals vaccinated with the various types of vaccine during the second series of field inoculations, and these animals will be submitted to contact infection and to inoculation with virulent blood. It will be decided upon the results of these test inoculations whether all the remaining vaccinated animals on this estate shall be tested with virulent blood or by the serum-simultaneous method.

The results of experimental observations on the virus of rinderpest and of the progress of prophylactic vaccination have been published during the year.

B.—EAST COAST FEVER.

The Assistant Chief Veterinary Research Officer proceeded on leave on the 21st January, 1928, and took with him ticks infected with East Coast fever and other piroplasms. His leave was spent at the Molteno Institute, Cambridge University, in the study of methods likely to yield a knowledge of the life-history of the parasite of East Coast fever. Observations were made upon ticks fed on experimentally produced cases of East Coast fever, and upon ticks fed on dogs suffering from piroplasmosis. This work is being continued now that he has returned to duty in Kenya. An organised search for drugs active against haemosporidia is in progress in Europe, and tests of experimental drugs are being made at the Molteno Institute. Should any compound active against the plasmodium of birds be discovered the department will at once be notified, and arrangements can no doubt be made to obtain samples of the drug for experiments with East Coast fever. Similar experiments are in progress in Germany, chiefly in the experimental therapeutic laboratories of the I.G. Farbenindustrie

Aktiengesellschaft, which were visited in September, 1928. These studies, under the direction of Dr. Roshl, have already resulted in the production of plasmochin, a synthetic compound which is being largely used in the treatment of various types of malaria. The I.G. Farbenindustrie Aktiengesellschaft has already, as a result of this visit, supplied the laboratory with a quantity of its newest preparations, which are being tested in the treatment of trypanosomiasis, piroplasmosis, and East Coast fever.

During his residence in Cambridge the Assistant Chief Veterinary Research Officer was able to discuss the question of tick-parasites with Professor R. A. Cooley, of Montana, U.S.A., who was visiting the Molteno Institute to obtain certain information with regard to ticks. Professor Cooley has for some years been working with Chalcidid parasites belonging to the Encyrtinae, with particular reference to the control of *Dermacentor andersoni*, the vector of Rocky Mountain spotted fever. Destruction of this tick by such measures as dipping is impracticable, both on account of its wide host-range in the adult stage, and on account of the fact that the larval and nymphal ticks are reared largely on small rodents. Professor Cooley has now a considerable staff of men devoted entirely to work in connection with tick parasitization.

The first parasite of ticks was discovered some years ago by Brumpt in Paris on a species of *Ixodes* taken from deer in the Forest of Fontainebleau. Subsequently parasites were discovered in *Rhipicephalus sanguineus*, the common dog tick, in U.S.A., and in Portuguese East Africa. The parasites have been referred to two separate species, but it is doubtful if specific differences do exist. Professor Cooley was of opinion that both parasites came in all probability in the first place from Africa, and he proposed visiting South Africa with the idea of discovering any additional parasites that might occur naturally. He was successful in finding a colony of the parasites operating with apparent success against a third species of tick some 25 miles from Pretoria. The species of tick concerned in this case was *Hyalomma aegyptium*, the " bont-leg " tick. This record is of greater interest, since the " bont-leg " tick differs considerably from the other species in general structure, the integument in particular being considerably thicker than that of Rhipicepalid or Ixodid ticks. The parasite from South Africa appears to be morphologically indistinguishable from the previously described species, but it is remarkable that the period required for development under standard conditions is approximately half that taken by the European and American species. The following is a brief account of the life-cycle of the parasite. The adult is a small Hymenopterous fly about the size of a comma in ordinary newsprint. Females are born in excess of males in a ratio of approximately 3 to 1,

and copulation takes place immediately after the adult emerges. The female flies now seek suitable host animals which are carriers of the ticks in which they wish to deposit their eggs. The eggs are deposited beneath the integument of the nymphal tick whilst it is feeding on the host animal, and further development takes place within the body of the fed nymph. The eggs are laid in clusters of three or four, but the female may strike an individual tick several times, and up to seventy flies have been known to emerge from a single parasitized nymphal tick. Evidence of parasitism is shown by the engorged nymph in from 20 to 40 days after dropping off. The first sign is the appearance of brownish maculated patches on the dorsal or ventral surface of the abdomen. After a further period of 40 days in the case of the American parasite, or about half this period in the South African parasite, the adult flies emerge from the body of the dead tick. The larvae of the parasite have consumed the entire contents of the tick, which is thus reduced to an empty shell. Pupation then takes place and the flies finally emerge as adults. Flies have been liberated in certain areas of the United States and data are now being collected as to the bionomics of liberated parasites and the establishment of definite colonies. The flies have been observed to travel as far as 300 yards in a few moments when seeking host animals in which to deposit their eggs.

A remarkable feature is the adaptability of the parasite to host species other than that in which it has been accustomed to live. Professor Cooley has been able to adapt both European and American species to parasitize *D. andersoni*, and the process can be effected in three or four generations. Professor Cooley was invited to visit this Colony, and the Assistant Chief Veterinary Research Officer had the privilege of accompanying him on a short safari through certain selected areas. It was his opinion that such an expedition would, in addition to furnishing data as to the occurrence of parasites in this area, bring to light interesting features in the bionomics of our important tick species. Our knowledge of the life-histories of these species, and more particularly of the part played by small game animals and vermin in the life-cycle is incomplete; and it is suggested that a complete survey of the country by competent workers could not fail to produce results of importance to the development of the stock industry in its campaign against tick-borne diseases of live stock. During the safari a large number of samples of nymphal ticks was collected. These are being held under observation for evidence of parasitism. Any ticks that fail to show parasites will be reared in the ordinary way to the adult stages, which will be identified. Larval ticks will similarly be reared to adult stage for identification. In addition to the larval and nymphal ticks, considerable numbers of adult ticks were collected from domestic

animals and vermin. The Assistant Chief Veterinary Research Officer examined these specimens, and there are several records of interest, including what appears to be the South African paralysis tick, *Ixodes pilosus*, which was collected in the Ngobit area from sheep and dogs. The specimens in the collection have been classified, and are now being forwarded to Professor Nuttall for confirmation of the determinations.

Dr. S. H. Whitworth carried out experiments with the view to observing the function of the spleen in East Coast fever immunity, and whether splenectomy of East Coast fever recovered bovines would result in a breakdown to East Coast fever or reinfection on exposure.

(A) Splenectomy of Bovines Susceptible to East Coast Fever and Exposure of same to East Coast Fever Infection.

Five cattle (Laboratory Nos. 2785, 2718, 2707, 2696 and 2505) splenectomised 10 to 12 days prior to exposure.

Result.

All five died of East Coast fever with acute East Coast fever post-mortem lesions. Temperature reactions not marked.

Conclusion.

Splenectomy did not increase the resistance to East Coast fever.

TABULATED RESULT.

Bovine No.	Splenectomized	Exposed in E.C.F. Camp	1st Rise in Temperature	Result
2785 ..	23-11-28	4-12-28	20-12-28	Died 28-12-28 E.C.F.
2718 ..	21-11-28	4-12-28	17-12-28	„ 25-12-28 „
2707 ..	22-11-28	4-12-28	21-12-28	„ 26-12-28 „
2696 ..	22-11-28	4-12-28	20-12-28	„ 24-12-28 „
2505 ..	21-11-28	4-12-28	22-12-28	„ 26-12-28 „

(B) Splenectomy of Bovines Reacting to East Coast Fever.

Three cattle (Laboratory Nos. 2705, 2814, and 2817) splenectomised immediately on appearance of Koch's bodies in gland smears. These appeared from 24 to 36 hours after first rise of temperatures.

Result.

All three died of East Coast fever with acute symptoms and typical post-mortem lesions.

TABULATED RESULT.

Bovine No.	Exposed in E.C.F. Camp	1st Rise in Temperature	Splenectomized	Result
2705 ..	16–11–23	29–11–23	30–11–28	Died 3–12–28 E.C.F.
2814 ..	23–11–23	6–12–23	7–12–28	,, 11–12–28 ,,
2317 ..	23–11–28	6–12–23	7–12–23	,, 14–12–23 ,,

Conclusion.

Splenectomy did not favourably influence the resistance to, or course of, the disease.

(c) Splenectomy of Bovines Immediately Prior to Temperature Reaction to East Coast Fever.

Two cattle (Laboratory Nos. 2840 and 2893) splenectomised on the 12th day after exposure in the East Coast fever camp. (*Note* : The average period between exposure and first rise of temperature to East Coast fever infection in this camp is 14 days.)

Result.

Both died of East Coast fever with acute symptoms and typical post-mortem lesions.

TABULATED RESULT.

Bovine No.	Exposed in E.C.F. Camp	Splenectomized	1st Rise in Temperature	Result
2340 ..	29–11–28	11–12–28	12–12–28	Died 21–12–28 E.C.E.
2893 ..	29–11–23	11–12–28	13–12–23	,, 24–12–23 ,,

Conclusion.

Splenectomy did not favourably influence resistance to, or course of, the disease.

(d) Splenectomy of Bovines Previously Recovered from East Coast Fever Infection.

Six recovered East Coast fever bovines (Laboratory Nos. 1344, 1355, 1336, 638, 2248, and 2480) were splenectomised, and all except No. 2248 exposed after periods varying in individual cases from 14 to 20 days, to East Coast fever infection. Bovine No. 2248 was never exposed.

Result.

They all showed recrudescence of Gonderia mutans, redwater, and anaplasmosis parasites in the blood, with fatal results in three cases. Gonderia mutans appeared in the red cells in enormous numbers, as in the case of Theileria parva in East Coast fever infection, but no Koch's bodies were seen, although gland smears were examined daily. One animal, No. 1336, showed Koch's bodies in gland smears with temperature reaction 24 days after exposure.

TABULATED RESULT.

Bovine No.	Splenectomized.	Exposed in E.C.F. Camp.	Result.
1344 ..	31–10–28	20–11–28	Died 25–11–28 Redwater.
1335 ..	1–11–28	20–11–28	Still living.
1336 ..	2–11–28	20–11–28	E.C.F. Reaction 15–12–28. Still living.
638 ..	19–11–28	4–12–28	Died 16–12–28 Redwater.
2480 ..	20–11–28	4–12–28	Died 19–12–28 Redwater.
2248 ..	20–11–28	Not exposed	Still living.

Conclusions.

Splenectomy of East Coast fever recovered bovines does not produce a breakdown to East Coast fever infection. Although one animal (No. 1336) showed East Coast fever infection on exposure this was probably a re-infection in an animal not completely immune. This experiment is being repeated in East Coast fever *recently* recovered animals to determine whether or not splenectomy will cause either a breakdown to infection or lessen the immunity in such animals with re-infection on exposure.

THE VALUE OF STERILE SPLEEN AND GLAND EXTRACT OR EMULSION IN PRODUCING IMMUNITY.

The spleens and glands of animals reacting to East Coast fever were removed after slaughter, minced well, and to each gram of minced material was added 4 c.c. of sterile normal saline containing 1 in 1,000 formalin. The material was kept at least four days in the ice chest before use.

Five cattle (Nos. 2830, 2751, 2837, 2829, and 2786) were put on the experiment.

Result.

All five became infected with East Coast fever on exposure.

TABULATED RESULT.

Bovine No.	Dates of Inoculation and Amounts of Material given.											Exposed in E.C.F. Camp	1st Temp. Rise	Final Result
	December, 1928							January, 1929						
	10	11	13	16	20	25	28	3	5	8	13			
2830 ..	10 c.c.	20 c.c.	30 c.c.	30 c.c.	40 c.c.	40 c.c.	40 c.c.	50 c.c.	50 c.c.	50 c.c.	50 c.c.	29-12-28	14-1-29	Died 20-1-29 E.C.F.
2715 ..	ditto							ditto				29-12-28	10-1-29	,, 18-1-29 ,,
2837 ..	ditto							ditto				29-12-28	13-1-29	,, 21-1-29 ,,
2829 ..	ditto							ditto				29-12-28	14-1-29	,, 22-1-29 ,,
2786 ..	ditto							ditto				29-12-28	16-1-29	,, 31-1 29 ,,

Conclusion.

The material as prepared gives no indication of value in protecting animals against fatal infection to East Coast fever on exposure.

General Summary and Conclusions.

1. Splenectomy of East Coast fever recovered bovines did not produce a breakdown to East Coast fever, and did not render the animals susceptible to infection.

2. Splenectomy of bovines recovered from redwater and anaplasmosis and Gonderia mutans infections produced breakdowns to these infections in nearly all cases, with sometimes fatal results.

3. In bovines showing very heavy infection of blood cells (100 per cent.) with Gonderia mutans after splenectomy, no Koch's bodies were observed. This does not definitely prove that bodies identical with Koch's bodies are not associated with Gonderia mutans infection as suggested by Theiler, but would appear to throw some doubt on this suggestion.

4. Splenectomy of susceptible bovines either some time before exposure or immediately before reaction, or during reaction of East Coast fever infection, does not favourably influence the course of the disease.

5. Spleen and gland extracts prepared and inoculated as above are of no value in protecting bovines from fatal infection with East Coast fever.

C.—BOVINE PLEURO-PNEUMONIA (LUNG SICKNESS OF CATTLE).

In 1921 the writer recorded that lymph virus becomes attenuated by subculture; since then a subculture of the 25th generation and subsequent generations in Martin's peptone beef bouillon medium brought to Ph=7.8 and additioned with ten per cent. bovine serum, have been issued for vaccination purposes. The experience is that the attenuated culture produces mild reactions and little mortality. At about the 50th-60th generation of subculture the virus becomes too attenuated and produces practically no reaction and little, if any, immunity, and it is necessary to substitute a 25th generation subculture of another strain or increase the virulency of the strain in use before it becomes too attenuated by passage through cattle, and subculture this till the desired attenuation is reached. The variations in susceptibility of cattle to pleuro-pneumonia inoculation present difficulties in testing the virulency of vaccine and necessitate the use of a large number of susceptible cattle.

Previous to the issue of a new lot of vaccine, it should be tested on its potency by subcutaneous inoculation behind the shoulder and in the tail of known susceptible cattle, and arrangements for the experimental inoculation of several hundred of cattle should, if possible, be made with an owner.

The suitability or otherwise of a vaccine for use in the practice is decided on the nature of the reactions which occur without treatment. If the reactions behind the shoulder are large in size and show a tendency to extend, and a mortality of from approximately 5 per cent. and upwards occurs and the reactions in the tail show a tendency to extend to the root of the tail and invade the pelvis, the vaccine is considered to be too virulent for issue. On the other hand, if the mortality from the shoulder inoculation amounts to not more than one to two per cent., and the reactions are not severe, the vaccine is issued for the tail inoculation, and owners are advised to watch the reactions and cauterise above the swelling should they show a tendency to extend up the tail.

It is the experience that a percentage of susceptible animals do not react to the original tail inoculation but may react to a second or subsequent inoculation. It is accordingly recommended that cattle should be re-inoculated in the tail after an interval of 21 days and re-inoculated behind the shoulder after a further 21 days' interval.

In Kenya Colony outbreaks of pleuro-pneumonia are dealt with by vaccination of in-contacts and quarantine of affected animals; compulsory slaughter is not enforced.

The issues of vaccine in 1928 amounted to 284,345 doses. Stock-owners as a rule do not take precautions to control the reactions when necessary, and in order to maintain the vaccine at a degree of virulency so that it will cause no serious mortality and confer immunity, frequent testing of the vaccine by subcutaneous inoculation behind the shoulder and in the tail, and the subsequent testing of the animals on their immunity with a more virulent virus, should be carried out.

Investigations were undertaken with a view to the introduction of a vaccine which produces little or no reaction and confers immunity. A culture in bouillon Martin beef bouillon additioned with 10 per cent. horse serum was substituted for the culture in bouillon Martin beef bouillon additioned with 10 per cent. bovine serum.

Experiment 1983 of the 28/8/28.

(1) 1 c.c. of a 2nd generation subculture in bouillon Martin beef bouillon medium additioned with horse serum of a 2nd generation of lymph virus in bouillon Martin additioned with bovine serum was used, and (2) in another instance of a subculture of the 22nd generation in bouillon Martin additioned

with bovine serum, was used for the subcutaneous inoculation behind the shoulder of 27 young susceptible cattle, ages approximately 6-15 months.

Result.

(1) 24 severe reactions occurred, of which twelve were treated by incision; the mortality amounted to 1=3.7 per cent.

(2) 1 c.c. of a 22nd generation subculture in bouillon Martin medium additioned with 10 per cent. horse serum as above was used in the inoculation behind the shoulder of 7 susceptible cattle.

Result.

Two reacted definitely, 3 reacted slightly and 2 showed no reaction.

Conclusions.

Substituting horse serum for bovine serum does not protect against severe reactions.

The immunising properties of (1) a 4 days old pure culture of the 3rd generation subculture treated with 2 per cent. commercial formalin, and (2) of pleuro-pneumonia tissue, collected from a beast reacting severely to the subcutaneous behind the shoulder inoculation of virus, treated after pulping with 2 per cent. commercial formalin, was also investigated.

Experiment 2005 of the 19/12/28.

Ten cattle were inoculated behind the shoulder each with 10 c.c. of the formalised culture and 10 with 10 c.c. of the formalised tissue.

Result.

No specific reactions occurred.

The cattle were tested on their immunity 26 days later with 1 c.c. of pure culture virus of the 33rd generation subculture, 10 in the tail and 10 behind the shoulder.

Result to date, 1/2/29.

	Severe reaction.	Marked.	Slight but definite.	Nil.
Shoulder inoculation ...	4	1	2	3
Tail inoculation ...	1	2	6	1

Conclusions.

Pure culture vaccine of the 3rd generation subculture treated with formalin has no immunising properties.

Formalin extract of pleuro-pneumonia tissue has no immunising properties.

D.—REDWATER—GALLSICKNESS.

With a view to increasing the number of vaccine producers, several young cattle, kept tick-free from birth, the progeny of the Laboratory breeding herd, were inoculated with blood of the bovine, *viz.*, No. 8844, which has been used since June, 1924, for supplying redwater-gallsickness vaccine.

Blood of 8844 invariably transmits anaplasma centrale, but from the results of inoculation of imported cattle which are kept under close observation when undergoing immunisation, the vaccine appears to be little virulent for redwater, and it was decided to infect the new vaccine producers with another strain of redwater.

The latter was obtained from a recovered redwater-gallsickness beast, and was isolated from the anaplasma infection by passage through susceptible calves; blood was collected at each passage as soon as the calf commenced to react to redwater, and 5 c.c. inoculated to another susceptible calf. Blood of the third passage was injected to a beast which had previously been injected with anaplasma centrale blood. Blood of the new vaccine producers has been tested on newly born calves kept tick-free from birth, but owing to their resistance a definite reaction did not always occur to either redwater or anaplasma centrale.

Newly born calves reared on their mothers are thus not always suitable for testing the blood of new vaccine producers. Blood of vaccine producers should preferably be tested on imported British cattle.

Testing the blood of naturally recovered redwater-gallsickness (anaplasma marginale) cattle and of vaccine producers furnished data on the pathogenicity of redwater and gallsickness in young calves reared on their mothers; it was found that they may react mildly to both infections, or in some cases there is no apparent reaction to either infection and parasites are not demonstrable in smears of the peripheral circulation, or they are so rare that they escape careful detection.

The low susceptibility of newly born calves to redwater and gallsickness may be put to a practical use in connection with the immunisation of cattle against these diseases. In view of the decrease in the incidence of redwater and gallsickness in regularly dipped cattle, and the risk of their contracting both infections if inoculated with rinderpest blood containing these infections and the inadvisability of rearing cattle susceptible to redwater and gallsickness under conditions at present existing in the Colony, it is suggested that calves reared under ranching conditions on estates where dipping is regularly carried out be inoculated at birth or shortly after with blood of a

known recovered from natural infection redwater and gallsickness beast. Further observations are indicated to determine whether re-inoculation is necessary to maintain a resistance to redwater and anaplasmosis.

In the case of dairy-reared calves exposed to tick infection the resistance to redwater and gallsickness is lower, and there is usually some mortality, and, in addition, complications with paratyphoid or other intestinal bacteria are likely to occur, particularly when the animals are reacting to anaplasmosis. There would thus be a risk in inoculating dairy-reared calves at or just after birth with blood of a naturally recovered beast, but vaccination at birth with vaccine containing a mild strain of redwater and gallsickness may be of assistance. In any case, a few head should first be inoculated and results noted.

The Effect of Tartar Emetic on the Viruses of Redwater and Gallsickness (P. bigeminum and Anap. marginale) *in vitro*.

Blood which *invariably* transmits redwater and gallsickness was treated with tartar emetic for 30 minutes prior to inoculation. 1 of tartar emetic to 20,000 parts of citrated blood (equal parts of blood and citrate) and 10 c.c. inoculated to a calf, No. 2912, age 2½ months, kept tick-free from birth.

Result.

On the 35th day after inoculation and on subsequent dates, blood of calf 2912 showed microscopically anaplasma marginale parasites and on the 41st day redwater parasites. From the 32nd to 48th day the temperature of the calf was elevated; maximum 104.2°F. 45th day. The animal remained apparently healthy and on the 67th day was discontinued from experiment.

Conclusion.

Blood treated for 30 minutes with tartar emetic, 1 in 20,000 parts of citrated blood, remains virulent for redwater and anaplasmosis.

E.—HEARTWATER.

During the year a good deal of time was given to the diagnosis of heartwater in cattle and sheep, with a view to determining the incidence of the disease in Kenya Colony.

The diagnosis can be made with some certainty from microscopical examination of smears of brain, kidney and spleen, provided the material is collected from an affected animal during the temperature reaction or immediately after death, but animals are as a rule not under sufficiently close daily observation, and owners do not always care to destroy a beast for collection of material for diagnostic purposes.

Nevertheless, it has been possible to determine the existence of the disease on several estates, and heartwater would seem to be more prevalent than is generally recognised.

The mortality in cattle, sheep and goats born and reared on heartwater infected farms does not appear to be heavy.

Observations on the mortality in susceptible cattle of about 2 years old when moved to an infected area showed that the death rate amounted to approximately 20 per cent.

Dipping in an arsenical dip offers the best means of combatting the disease.

During the year Professor R. W. M. Mettam dealt with anthrax, blackquarter, contagious abortion and sterility, Laikipia lung disease, diseases of the goat, plant poisoning, and took over the preparation of horse-sickness serum and immunisation of horses against horse-sickness. This officer's report is recorded hereunder.

F.—ANTHRAX.

The position as regards anthrax has not changed during the year. In December, 1928, the first brew of an anthrax spore vaccine for use on cattle was prepared, but until it has been exhaustively tried with satisfactory results on experimental animals under field conditions, it will not be issued to stock-owners.

This spore vaccine is prepared from the same strain which has given consistently good results in South Africa, where anthrax is much more virulent than in this Colony. The dose of the vaccine will be small ($\frac{1}{2}$ c.c.), and this may prejudice some farmers against it, just as several farmers have already complained about the small dose of the liquid blackquarter vaccine.

The spore vaccine, like the double vaccine at present in use, is prepared from attenuated living organisms, and confers immunity lasting from 12 to 18 months. Annual vaccinations must therefore be carried out.

The advantages of the spore vaccine are (1) that only one inoculation is necessary, and (2) that a more secure immunity is produced than after the use of the old double vaccine.

It is generally known that the double vaccine may be used on all the different domestic animals in various doses, but the spore vaccine must only be used on the particular species of animal indicated on the label of the bottle. Thus the spore strain for cattle and sheep must not be used on the more susceptible animals like the horse, goat or pig, or else clinical cases of anthrax will be produced in these animals.

That different strains of a spore vaccine must be prepared for the various domestic animals is undoubtedly a drawback in a country where relatively few doses are issued every year for animals other than bovines, and for these animals it may be better to continue the manufacture of the old pasteurian vaccine. Experience in other parts of Africa has shown that the inoculation of the second pasteurian vaccine intradermally or by cutivaccination to such susceptible animals as the horse, sheep and pig gives as good results as a spore vaccine given subcutaneously.

G.—BLACKQUARTER.

The liquid vaccine has been issued to stock-owners throughout the year. While the great majority of farmers appear to have confidence in this vaccine, several complaints have come to hand of so-called breakdowns.

As no muscle has been forthcoming from these breakdowns for bacteriological examination, it is impossible to say whether they are really due to the blackquarter organism or to some other closely allied anaerobic bacteria. Should they be due to the blackquarter organism then the efficacy of the liquid vaccine would appear to be uncertain in its immunising powers under field conditions. But, at present, our knowledge is such that the efficacy of this vaccine cannot be even doubted.

Many farmers maintain that the dose of vaccine is too small to be administered with ease and certainty, and declare that possibly some of the deaths which are encountered in vaccinated animals may be explained by animals not receiving their proper dose. In order to overcome this difficulty the dosage has been increased for the time being to 3 c.c. per animal.

Blackquarter is undoubtedly a very acute infection on many farms and readily attacks calves under 6 months and cattle over 4 years. Where such cases occur it is recommended that calves of 4-6 months be inoculated with 2 c.c. vaccine and again inoculated with a full dose when they are 10 months old, and subsequently every 10 months or annually.

It must be realised that after vaccination an active immunity does not develop for 14-21 days so that cases which appear in this interval were probably in the period of incubation when they were inoculated.

The vaccine is a sterilised culture of the *B. Chauvei*, and is absolutely incapable of causing or producing the disease in inoculated animals.

Cases dying from a haemorrhagic gaseous condition of some of the large muscle masses with haemorrhagic infiltration of the subcutaneous and intermuscular tissues, are always

diagnosed by laymen as blackquarter. It is now recognised in many countries that there are at least two other anaerobic bacteria besides *B. Chauvei* capable of producing such lesions, e.g., *B. oedematiens* and *B. malignant oedema*. It is not definitely known if these latter bacteria exist in this Colony, but their presence is strongly suspected. It is only by careful bacteriological work that they can be identified, and farmers are earnestly requested to send to the Laboratory muscle tissue from cases of so-called blackquarter. It will be readily understood that the Laboratory vaccine which is prepared from several strains of the true blackquarter organism, will not protect animals from attacks of other anaerobic bacteria. Farmers should therefore send periodically to the Laboratory specimens of muscle, which can be subjected to careful bacteriological scrutiny, when the exact cause of the condition will be determined. This procedure is especially to be recommended in cases which are said to be breakdowns to blackquarter after use of the liquid vaccine.

All that farmers have to do is to excise pieces of badly affected muscle, cut into thin strips and dry in the sun for a few days. Precautions should be taken against dust and flies, and when the muscle is dry like biltong it should be despatched to the Laboratory in a clean tin or stoppered bottle *without* any preservative. Muscle sent in spirit, in formalin solution or undried is not suitable for bacteriological work.

At present there is only one local strain of the blackquarter organism in use at this Laboratory, and in order to increase the value and efficacy of the vaccine it is desirable to obtain as many local strains as possible.

In order therefore to perfect our knowledge of blackquarter and other allied infections in this Colony, and to maintain the high efficacy of the Laboratory blackquarter preparation, it is most necessary that all farmers should co-operate in every possible manner in this investigation.

H.—CONTAGIOUS ABORTION AND STERILITY.

Judging from the agglutination tests made during the year it would appear as if contagious abortion is a very widespread disease in this country.

It is responsible for immense economic loss every year, but it is apparent that the farming community as a whole does not yet realise the seriousness of allowing the disease to exist uncontrolled amongst breeding cattle. Undoubtedly native cattle are heavily infected and are responsible for introducing the disease on to many farms.

During the year a brochure on " The Prevention and Control of Contagious Abortion " was printed and is now available for stock-owners. Reference should be made to it for the latest information on vaccination, control and eradication, *sequelae*, methods of infection, etc.

For the first time equine contagious abortion was diagnosed in this Colony during the year. The outbreak died out naturally, as is very often the case, but should a recrudescence of the disease occur steps will be taken to vaccinate all in-contact pregnant mares.

In order to obtain information on the prevalence of sterility in this Colony a printed form was issued to many farmers who have had contagious abortion amongst their herds during the past few years. Over 400 of these forms were issued but so far (six months after) only 25 have been returned to the Laboratory.

A critical examination of these returns shows that most farmers are quite ignorant of the breeding histories of their cattle and therefore are not in a position to supply the most important and fundamental information necessary in the preliminary investigations into the cause of sterility in this Colony.

It has frequently been emphasised that 90 per cent. of sterile cattle are suffering from ovarian or uterine lesions or both. These conditions are the sequel of contagious abortion, and therefore preventible. It must be realised that once the ovaries and particularly the uterus become the seat of marked pathological lesions, it is a difficult and frequently an impossible task to restore the normal physiological functions of these structures.

In some investigations, where practically whole herds failed to conceive, the bull or bulls have been inculpated. The cause of sterility in the male is not always clear. It may be due to induration of the testicles, to abscesses in the male genital organs, etc., which in some cases are due to the bacillus of contagious abortion. But sterile males frequently occur in herds where the disease does not exist or in animals negative to the agglutination test and free from the disease. The cause of this sterility is difficult to explain and may well be eventually traced to some mineral or vitamin deficiency in the food.

Many farmers maintain that the worst cases of sterility occur in pregnant animals, which abort while they are going through some febrile disease, *e.g.*, East Coast fever or rinderpest. This statement is quite true, and the explanation is that in acute febrile diseases the lining membrane of the sexual canal becomes just as acutely inflamed as all the other mucosae

throughout the body. As result of the inflammation, pathological changes occur which may terminate unfavourably, and leave permanent injury to the lining mucosa, thereby making further pregnancies impossible.

I.—HORSE-SICKNESS.

During the year the preparation of serum was continued, and at the end of December 32,800 c.c. were in stock, *i.e.*, enough for the immunisation of 41 animals at the rate of 800 c.c. per animal.

The serum is prepared by immunising suitable horses in the usual way and a month or so later hyperimmunising by direct transfusion of 10 litres of blood from a virus maker at the height of the disease. After a further period of 3-4 weeks the hyperimmunised animal is bled on several occasions, its serum collected and mixed with the sera of other animals similarly treated, and kept in a dark cool room until required.

It will be noticed that this process is a long and costly one, for several animals have to be sacrificed as virus makers, and it is by no means unusual for immune horses to develop horse-sickness after hyperimmunisation and succumb.

Several inquiries have been received from horse-owners during the year *re* immunisation against horse-sickness. It must be distinctly understood that the horse-sickness serum has no curative action when inoculated into sick animals even in massive doses. The serum is entirely prophylactic, as when used in conjunction with the virus it confers a very sound active immunity.

Immunisation of horses can only be carried out at the Laboratory, and owners wishing for fuller information on the procedure for sending animals to the Laboratory should communicate with the Chief Veterinary Research Officer. Owners must be prepared to take all risks, to pay all expenses incurred while the animal is undergoing immunisation, etc.

It has been noticed in South Africa that a certain percentage of animals which have been successfully immunised against horse-sickness develop a peculiarly fatal disease known as acute liver atrophy.

This condition was the subject of an exhaustive investigation by Theiler, who observed it in animals after immunisation by Laboratory methods and in salted animals, *i.e.*, those which have recovered from a natural attack of the disease. Some animals, however, died from acute liver atrophy without there being any history of them having ever had horse-sickness.

A case of acute liver atrophy was first observed at Kabete in equine No. 1251. This animal did not present the classical symptoms of acute liver atrophy during life, but, on autopsy,

the liver was the seat of extensive pathological changes very similar to those described by Theiler in liver atrophy.

Theiler was unable to demonstrate the exact cause of liver atrophy. He believed that the primary cause was probably a plant toxin which had a specific action on the liver, *c.g.*, *Senecio latifolius*, while secondary causes were the toxin of the horse-sickness virus and environmental factors.

Many cases have been observed in animals prematurely worked after immunisation or exposed to extreme climatic conditions.

Animals react to horse-sickness between the 9th and 16th days after the first inoculation and in order to obviate any likelihood of staggers it is recommended that between the 11th and 21st days after injection the animals should be stabled, kept quiet and given soft nutritious foods.

No explanation can be presented to explain the case of liver atrophy which occurred at Kabete. The plant toxin and environmental conditions can apparently be excluded, for no known species of Senecio was fed to the animal for some time prior to immunisation, and certainly none was during the process of immunisation, while every precaution was taken to nurse the animal as carefully as possible during the immediate critical post-inoculation period.

Several animals were successfully immunised at Kabete for a farmer on the Ngobit. The efficacy of the Kabete inoculation will be only put to proof when Laboratory immunised animals are exposed to infection in notoriously bad horse-sickness districts.

Finally, it may be mentioned that the reservoir of the virus has not yet been found, despite very exhaustive attempts. It is known that the virus exists in the blood of recovered animals for a considerable time, and it is not improbable that recovered equines themselves may help to harbour infection in certain districts. Many observant farmers believe that the zebra is the main reservoir, and quote instances where horse-sickness has died down with the disappearance of zebra from the district. There is, however, no scientific confirmation that zebra are any more to be inculpated than any other game.

J.—LAIKIPIA LUNG DISEASE.

This disease is spreading rapidly and will, no doubt, be found all over the settled areas if sheep are moved as indiscriminately in the future as they are at present. Infection is carried by sheep with pulmonary lesions, and sheep on a farm where the disease is non-existent are very susceptible. Recently a stock-owner on the Aberdares purchased sheep from

the Nyeri district, a notoriously dirty area as far as Laikipia lung disease is concerned, and mixed the new flock with his own clean ones, with the result that he is now suffering considerable losses from Laikipia lung disease. Too much care cannot be exercised over this disease, and farmers purchasing sheep from areas where this disease is known to exist should not mix the new flock with his own clean ones, without making sure the purchased flock is clean of the disease. It is recommended that new purchases should be isolated for 2-3 weeks before mixing with the clean animals. Sheep which appear healthy at the time of sale may relapse suddenly when they are subjected to new conditions, *e.g.*, climate, fatigue after travelling, etc. This is particularly true, naturally, if there are " chronic lungers " in the purchased flock.

Considerable attention has been paid to this disease throughout the year, and the following facts may be briefly summarised, *viz.* :—

1. While the disease is specific for sheep, odd cases may be encountered in the goat. Cattle inoculated with virulent cultures or diseased lung tissues develop a fibrous pneumonia which is localised at the site of injection. There may be also an overlying fibrous pleurisy. For all practical purposes, however, cattle may be regarded as being highly resistant to the disease.

2. There are at least two different bacteria which are of etiological significance, *e.g.*, the Laikipia organism and a small gram positive diplococcus. It seems as if the latter agent is responsible for the purulent condition so often encountered in the lungs and pleural effusions. It has been finally proved that this disease is not due to a filtrable virus.

3. Under natural conditions infection nearly always occurs through the respiratory system.

4. The specific organisms have been recovered from the nasal discharges of animals in the acute phases of the disease.

5. Animals which have apparently recovered clinically from the disease may relapse suddenly, develop acute symptoms and die when they are exposed to inclement weather, sudden changes of temperature after shearing, etc.

6. The specific Laikipia organism rapidly loses its virulence outside the animal body. It dies out *in vitro* in three weeks or so, and is rapidly destroyed by weak solutions of such common disinfectants as carbolic acid or formalin. In the Laboratory, unless the organism is contantly passed through sheep, its virulence may be lost in a few months.

7. The question of using avirulent cultures of the Laikipia organism for vaccine is now under consideration. A vaccine prepared from living bacteria is indefinitely better than one prepared with killed organisms, but until more is known *re* the behaviour of avirulent strains when used for vaccine purposes it is inadvisable to issue such strains for field inoculations.

At present the vaccine issued to sheep farmers is a formalised culture containing both the Laikipia organism and the diplococcus. It is not claimed that this vaccine is ideally efficient, but it is the best that can be issued with our present knowledge of the biology of the organisms.

K.—DISEASES OF THE GOAT.

Contagious Pleuro-pneumonia.

Opportunity was afforded during the rainy season of 1928 to study contagious pleuro-pneumonia of the goat. The following are some of the conclusions arrived at, *viz.* :—

(*a*) That the disease has a seasonal incidence and is at its worst during the heavy rains.

(*b*) That the causal agent is ultravisible and filtrable. Aerobic and anaerobic cultures on all the ordinary and many special media were consistently negative. In a few animals an organism was isolated from the lungs and bronchial glands. The role or function of this organism has not been yet determined.

(*c*) That the mortality may be as high as 90 per cent. Recovery does not confer active immunity, and relapses are very common.

(*d*) Experimentally the disease has been transmitted by actual contact, intratracheal inoculation of pleural effusions, and pulmonary tissues of typical cases of the disease.

It is very certain that under natural conditions infection is primary bronchogenic in origin.

(*e*) That this disease is absolutely specific for goats.

(*f*) That the corpuscular elements described by Mori and the fungi described by various authors as being found in the pulmonary tissues of animals suffering from pleuro-pneumonia have not been observed in this investigation.

Takosis.

It was mentioned in the Annual Report for 1927 that this disease possibly occurs in this Colony. Recently opportunity was given to study a chronic progressive cachetic disease in goats purchased in Nairobi for experimental purposes.

These animals are at present in a miserably poor condition with hollow flanks and pendulous bellies. There is an intermittent foetid dark tarry diarrhoea which extensively soils the tail and perineal region. The appetite is capricious, especially when the diarrhoea is present. All visible mucosae are pale, swollen and moist.

No opportunity has yet arisen to conduct an autopsy on these animals, but it is clear that in Kenya there exists amongst goats a condition very analogous to takosis as described in the United States.

L.—PLANT POISONING.

Several outbreaks of illness attributed to the ingestion of some poisonous plant have been investigated during the year, while as a routine plants collected locally have been fed to sheep in order to determine whether they are harmful or not. Some very interesting and important results have been obtained from the latter observations.

Further cases of Acokantherosis have also been investigated. They presented all the characteristic features described in the article on Acokantherosis in the Annual Report for 1927.

The following plants have been proved to be definitely poisonous for sheep in the amounts indicated, *viz.*: *Ranunculus pinnatus* (3050 grammes), *Asclepias platycalyx* (1772 grammes), *Dichrocephala chrysanthemifolia* (1584 grammes), *Cucumis prophetarum* (900 grammes), *Sium* (? *latifolium*), *Leonotis mollissima* (1867 grammes), and *Cassia didymobotrya* (in 2 cases 75 grammes and 180 grammes respectively).

All these plants set up acute gastro-enteritis with marked purging, etc. The symptoms caused by *Ranunculus pinnatus* and *Cucumis prophetarum* are very similar to what is seen in rinderpest, even down to ulceration of the buccal mucous membrane. Both these plants are so very acrid and irritant that it is doubtful if any animal would eat them under natural conditions.

The Ranunculus is a weed of damp places, vleis and banks of streams. Very often it is partially submerged, and its alluring greenness may attract animals in times when grazing is low. The Cucumis is a xerophillous plant and on account of the numerous stout bristles on stem and leaves it must only be eaten by cattle under very adverse conditions. Both sheep and goats, however, have been observed to eat the plant in small quantities while grazing.

Dicohrocephala chrysanthemifolia is a very poisonous plant which grows in vleis, damp places and in the open grasslands. It has the reputation amongst the natives of causing abortion in

pregnant animals, but in our experiments this has not been observed. It would seem rather as if the plant acts indirectly on the uterus by causing congestion of the pelvic viscera than as a specific ecbolic.

Cassia didymobotrya is a very poisonous plant, which causes an intense inflammation of the intestinal canal. The pods are harmless when an infusion of them is given in a drench, but an infusion of the leaves proved to be very toxic.

Cassia obovata is said to be poisonous in Australia and South Africa, while recently in Australia *Cassia sophera* has been shown to be quite innocuous. Senna tea, which is a common emodin cathartic, is prepared from the dried leaflets of *Cassia acutifolia* or *Cassia angustifolia*, while the ripe fruits of *Cassia fistula* are also sometimes used for the treatment of acute constipation. The Kenya Cassias therefore are closely akin to plants which are of great medicinal value and this fact, according to Battiscombe, is well known to the Masai, who use an infusion of the leaves of *C. didymobotrya* as a purgative. There is no doubt, however, that in even moderate doses, *e.g.*, 72 grammes and 185 grammes, the leaves and shoots of this tree are exceedingly poisonous. Experiments are now in progress to determine the safe amount of leaves and twigs that can be administered to sheep as an efficient purgative.

(It is well known, of course, that most of the cathartics of vegetable origin are violent irritant poisons when taken in excess, and this is true of *Cassia didymobotrya*.)

The following plants have been proved to be non-poisonous for sheep, *viz.* : *Ipomoea cardiosepala; Lantana salvifolia; Pentas purpurea; Melothria longipedunculata; solanum incanum; chenopodium opulifolium; Typha australis;* and *gloriosa carsonii*. Some of these plants, *e.g.*, *gloriosa carsonii* and *melothria longipedunculata*, caused temporary symptoms of colic, uneasiness, salivation, etc., but recovery occurred although feeding was continued for some days following the appearance of these symptoms.

Tests were also conducted with the following plants, though the present results are not accepted as final, *viz.* : (*a*) *Tribulus terrestris*; (*b*) *adonia* (? species); (*c*) *oxalis acetosella*; (*d*) *Cissus erythrochlora*; (*e*) *polygonum tomentosum*; and (*f*) *Diplolophium abyssinicum*.

Tribulus terrestris is the cause of geeldikkop in sheep in certain districts of the Transvaal, Karoo, etc. It is only poisonous at one definite phase of its history—when it is flowering before rain. The material used in the Kabete experiment was obtained from the Kedong Valley. The plant

was in the later flowering stages, as some fruit had already appeared. No result was obtained after drenching a starved animal with 200 grammes. Probably the dose was too small to produce the disease.

It is noteworthy, however, that attempts to produce geeldikkop in sheep in Australia by feeding massive amounts of *Tribulus terrestris* have always failed even when all the necessary factors *re* climatic conditions, flowering plant, etc., are fulfilled.

Cissus erythrochlora is regarded by the Nandi and Lumbwa as excessively poisonous, but drenching with 711 grammes of the local plant did not cause any symptoms. Unfortunately, there was insufficient material at hand to pursue the investigation of this plant, but the first opportunity will be taken to examine it more fully.

Oxalis acetosella (sheep sorrell) is said to cause a certain mortality every year on a farm on the N.E. slopes of Mount Kenya, at an altitude of over 9,000 feet. Feeding tests with the plant supplied by the farmer gave negative results, though the test cannot be regarded as conclusive, as only 5643 grammes were fed.

Both *oxalis acetosella* and *polyonum tomentosum* are plants which may well be toxic only under certain conditions. Uncertain and inconclusive results have been obtained with them in other countries where they have been experimented with. Further tests with large amounts of these plants must be carried out before any definite statement is made concerning their unsuitability as a food.

M.—AVIAN DIPHTHERIA.

(Fowl Pox.)

Supplies of the powder vaccine were prepared and issued during the year. The demand for the vaccine is increasing.

From observations at the Laboratory on vaccinated birds the results have been satisfactory. In some lots of birds diphtheritic lesions occurred on the tongue and elsewhere in the mouth as the result of vaccination. In such cases the birds showed little ill-effects and recovered without treatment.

Publications.

The research work carried out by officers of the Veterinary Research Laboratory during the year is recorded in the Department of Agriculture Annual Report, where reference is made to the Bulletins published thereon.

The following papers and articles were also published :—

" Helminthic Infestations of Natives in the Kenya Highlands," by R. Daubney and J. A. Carman.—*Parasitology*, vol. xx, 13th July, 1928, pp. 185-206.

" Observations on Rinderpest," by R. Daubney, M.S.c., M.R.C.V.S.—*Journal of Comparative Pathology and Therapeutics*, vol. li, Parts 3 and 4.

" Recent Contributions to our Knowledge of Poisonous Plants in the Domestic Animals."—*Veterinary Journal*, November, 1928, p. 562.

" Poisonous Plants and the Domestic Animals."—*Kenya Medical Journal*, June, 1928.

" The Atrio-ventricular System of the Equine Heart."—13th and 14th Reports of the Director of Veterinary Education and Research, Pretoria, 1928.

" An Introduction to the Study of Poisonous Plants of Kenya."—Address to the Veterinary Medical Association of Kenya, January, 1928; published in *Veterinary Record*, November 10th, 1928.

By R. W. M. Mettam, M.Sc., M.R.C.V.S.

The following are in press or being prepared :—

" Miscellaneous Anthelminthic Experiments on Sheep " (in Press).

" Revised Aids to Stock-Owners " (in preparation).

J. WALKER,
Chief Veterinary Research Officer

APPENDIX E.

ANNUAL REPORT OF THE AGRICULTURAL CHEMIST, 1928.

Staff Changes.

Mr. V. A. Beckley, Agricultural Chemist, returned from vacation leave on the 18th February.

Correspondence.

773 inward and 460 outward letters were dealt with; in addition 608 reports were issued.

Travelling.

777 miles of extra departmental travelling in connection with experimental work were performed.

The Assistant Agricultural Chemist was away from Nairobi on preliminary soil surveys for a total period of 46 nights visiting the following districts: North Nyeri, West and North Kenya, Nanyuki, Molo and Upper Molo, Uasin Gishu Plateau, Trans Nzoia, Nakuru, Rongai, Lower Molo, Solai, Upper Subukia, Upper Gilgil, Thomson's Falls, Laikipia, Londiani, Nabkoi, Timboroa and Equator.

The Agricultural Chemist was away for 3 nights in the Rongai area in connection with soil amelioration experiments.

Agricultural Show.

Milk tests were carried out in connection with the milking competition. An exhibit of soil profiles and physical properties of some soils was staged.

Work Done.

SAMPLES RECEIVED, 1142.

Sample	Outstanding at 31–12–27	Received	Examined	Refused	Outstanding at 31–12–28
Dips	7	522	513	16	..
Soils	17	471	39	11	438
Wireworm Remedy	..	29	26	3	..
Toxicological	..	22	17	5	..
Limestone & Lime	19	18	30	7	..
Manures	..	5	4	1	..
Cresoto	..	8	8	..	..
Water	1	7	7	1	..
Coffee Cherry	15	3	18	..	..
Yerbe Mate	..	3	3	..	..
Salt Bush	..	1	1	..	..
Foods and Feeding Stuffs	..	2	2	..	..
Miscellaneous	1	34	32	3	..
Sisal Juice Samples	..	17	17	..	..
	60	1,142	717	47	438

Routine.

Cattle Dips.

The number of dip samples submitted during the year shows a decrease. 16 samples were refused during the year; most of them bore no distinguishing mark or label and the senders could not be traced. A few samples were broken in transit to the laboratories.

Every year reference is made to samples incorrectly or incompletely addressed. Such samples are either delayed or lost, resulting in unnecessary correspondence and usually the submission of fresh samples by the owner.

The position regarding the number of samples dangerously incorrect remains unchanged. About one-third of the samples received represent dips which are either quite ineffective as tick-destroying agents or which injuriously affect the animals passing through them.

Result of Analysis of Dip Samples.

Extent of Error	1924		1925		1926		1927		1928	
	No.	%	No.	%	No.	%	No.	%	No.	%
Within 1%	15	3·4	27	5·8	36	6·6	38	5·88	30	5·85
Between 1% and 5% ..	77	17·4	80	17·1	89	16·3	119	18·42	81	15·80
Between 5% & 10% ..	78	17·6	73	15·6	94	17·2	95	14·70	103	20·07
Between 10% & 20% ..	109	24·6	112	24·0	134	24·5	170	26·31	127	24·75
Over 20% ..	164	37·0	175	37·5	191	34·9	216	33·45	172	33·53
Too Dirty to Analyse ..	..	..	..	..	3	0·5	8	1·24	..	..
	443	..	467	..	547	..	646	..	513	..

Soils.

While quite a number of soils have been submitted by farmers for analysis and in most cases have been examined, the majority of soil samples have been taken in connection with experimental work or in connection with the preliminary soil survey of the Colony now being undertaken by Mr. Gracie, the Assistant Agricultural Chemist in conjunction with Mr. Burton, the Plant Breeder. In connection with this work Mr. Gracie attended meetings at Burnt Forest, Eldoret, Kitale

and Nanyuki and at the three first places lectures were delivered. In all, in the preliminary soil surveys, over 400 samples have been taken.

In due course bulletins will appear upon the soil survey work.

Mechanical Analysis of Soils.

At the Imperial Agricultural Research Conference held in London in 1927 it was agreed that mechanical analyses should be performed according to the recently defined international methods which have been accepted by most of the nations of the world. In this method the organic matter of the soil is destroyed by means of hydrogen peroxide and the fractions are reported on the basis of their own dry weights.

In connection with a series of mechanical analyses, the results of which will be reported elsewhere, very great difficulty was experienced in the destruction of the organic matter. It was found in certain cases, notably of heavy black clays—black cotton soils—that, even after the consumption of very large amounts of hydrogen peroxide, much of the organic matter remained.

The weight of the fractions would, under these conditions, not be a true measure of the soil fraction but would represent the weight of the fraction plus an unknown amount of organic matter, a state that is manifestly unsatisfactory. This problem is being investigated further. Assistance has also been asked for from the Rothamsted Experimental Station, and from Professor Robinson of University College of North Wales, Bangor, the originator of the hydrogen peroxide treatment.

Analyses of Cherry Coffee, Coffee Pulp and Coffee Leaves.

The analyses of these referred to in last year's annual report have been and are being carried on by Mr. Gracie, Assistant Agricultural Chemist; twenty samples of cherry and pulp have been collected in connection with them as well as six samples of coffee leaves. Two of these samples of coffee leaves were normal in appearance while the other four were obtained because the leaves showed yellowing of some sort.

Soil samples to correspond with most of these samples of cherry and leaves have also been obtained and their analysis is proceeding.

Interesting results have already been obtained from this investigation.

Manurial Experiments.

Scott Agricultural Laboratories' Plots.

The group of 144 plots at the Scott Agricultural Laboratories was so badly damaged by the unusual rainfall of 7½ inches on the night of 7th May that the continuance of these experiments was impossible. Some of the plots were gullied to a dept of a foot while surface soil of the higher lying plots was to a very large extent removed and deposited on the lower plots. Under such conditions it was manifestly impossible to expect to obtain any results from the area. The whole group of experiments thus had to be abandoned.

An experiment with Seychelles guano by Mr. Gracie and Mr. Watt, the Assistant Agricultural Officer at the Scott Laboratories, had a better fate and was most successful. The results are reported by Mr. Gracie and Mr. Watt in bulletin form. It is proposed to continue this experiment in the coming year without further manuring. Further plots will also be laid out to compare the action of different forms of phosphate.

Manurial Experiments at Kasarini, Kyamlu.

The coffee bushes in these plots had suffered so much from the heavy crop of cherry they had produced during the droughts that it was decided to prune them heavily to give them a chance to recover. This area previous to the siting of the experiment had borne heavy crops and had not had a resting period so that the need of a resting period was accentuated by the heavy cherry crop. This year there is no crop at all.

The new growth shows that there is a response to manuring. It is, however, impossible to draw any conclusions from qualitative observations. Results obtained from direct weighings are essential before any definite conclusions can be drawn.

As a result of the observations made so far one fact has been established. This is that if during a drought year a fair crop of cherry is picked the amount of clean coffee obtained is small. The percentage of clean coffee as regards cherry in some cases dropped to as little as four while in a good year the percentage was as high as twenty. Under drought conditions it would appear that the fleshy part of the fruit develops at the expense of the seed which very often is most rudimentary and incapable of functioning as such.

Alcohol from Sisal.

Some years ago the subject of the possibility of using sisal waste as the raw material for the production of power alcohol was investigated by the late Chemical Research Department. Work was conducted upon material obtained from Messrs. Swift and Rutherfoord, Punda Milia. It was found in these

experiments that the sugar content of the juice was below 3 per cent. At this figure is was concluded that power alcohol manufacture was not an economic proposition.

During the past year rough details of the new Fouque process for the utilsation of sisal waste for the production of power alcohol were received by the Kenya Sisal Growers' Association at whose request the subject was reinvestigated.

Samples of pulp obtained by dry decortication or of the juice expressed from the leaves were taken at or received from Mr. E. D. Rutherfoord, Punda Milia; Mr. A. Bursell, Kalimoni Estate, Ruiru; Mr. J. McCrae, Longonot Ltd., Naivasha; and the British East African Corporation Ltd., Voi. The juice was analysed in the laboratories with the result given in Table I.

Table I.

Sample	Date	Specific Gravity of juice	Total Sugars in pure juice calculated as Dextrose. Grams per 100 grams
Kalimoni Estate, Ruiru ..	1–8–28	1·054	1·04
Kalimoni Estate, Ruiru	17–10–28	1·042	2·39
Kalimoni Estate, Ruiru	31–12–28	1·028	1·58
Punda Milia	1–8–28	1·054	1·52
Punda Milia	17–10–28	1·028	4·12
Longonot, Ltd., Naivasha ..	7–8–28	1·037	2·64
Longonot, Ltd., Naivasha ..	15–10–28	1·039	1·93
B.E.A. Corporation, Ltd., Voi ..	17–10–28	1·058	2·30

In only one case, that of the sample taken at Punda Milia on 17th October, was the sugar content over 3 per cent. The Punda Milia result is discussed below. In the production of alcohol from waste products for power purposes, the deciding factor is always the economic factor. Although several tons of fermentable sugar may be passing down the waste channels of a sisal factory each day it may be present in so low a concentration that the redemption allowance alone on the plant required for its conversion into alcohol may be sufficient to make the proposition quite unpayable. It is to be regretted that so far, except in the case of the Punda Milia sample of 17/10/28,

the sugar content of the ordinary day's run of sisal leaf is too low to allow of the profitable utilisation of the sugar as a source of power alcohol.

The Punda Milia sample of 17th October represented juice of leaves from the first cutting of a plantation. There was a possibility that the age of the plant from which leaves were obtained was a factor affecting the sugar content. Mr. McCrae of Longonot, when the matter was mooted to him, offered to obtain samples of juice from plants of various ages. To ensure that a fair average sample of each age was secured, leaves from a number of plants were taken, crushed, and a sample of the juice taken. (The age of the plants is their age in the plantation, the real age is about 18 months longer. This period was spent in the nurseries). The results of the analyses are given in Table II.

TABLE II.

Variation in Sugar Content of Sisal Juice with Age.

Age from Planting	Specific Gravity of Juice	Total Sugars in Juice calculated as Dextrose. Grams per 100 grams
1	1·034	2·0
2	1·034	2·3
3	1·029	3·0
4	1·032	4·3
5	1·032	3·6
6	1·036	2·7

These results indicate that the plant is accumulating sugar up to its fourth year at which age cutting usually commences. After this, the sugar content of the juice decreases. The high result obtained for the Punda Milia sample taken on 17th October is directly ascribable to the age of the leaves. In this connection it is of interest to record that the juice from some suckers obtained at Punda Milia contained just under 4 per cent. of sugars as compared with $1\frac{1}{2}$ per cent. in the juice from mature leaves crushed the same day.

It will be noticed that the figures for the sugar content of juice obtained in average running at Longonot is not quite comparable with the results obtained for the five- and six-year-old leaves. It is highly probable that weather conditions may affect the sugar content and that the differences may be traced

partly to this. To investigate this would, however, extend the investigation beyond that of the possibility of obtaining alcohol from sisal waste.

The conclusion to which one is forced is that, owing to certain unknown conditions in Kenya, as far as matters have been investigated, the juice from sisal has too low a sugar content to allow of the economical production of power alcohol. Although in certain cases the content rises high enough to reach the possibility of profitable alcohol manufacture the average content is too low.

Fermentation of Coffee.

It is definite that the removal of the mucous saccharine matter from coffee, effected in fermentation, is brought about by an enzyme in the material itself. There is, however, another factor concerned in the fermentation of coffee. This appears to be connected with acidity. It was hoped to investigate this condition during the year and so complete the study but, owing to delay overseas in fulfilling indents, a piece of apparatus necessary to prosecute the study did not arrive until too late in the coffee season for the work to be continued. It is intended to prosecute the research with the next coffee crop.

General.

With the year under review the chemical laboratories can now be considered to be fairly well equipped. The work it is now possible to undertake and which the staff are called upon to undertake is more than can conveniently be performed in the laboratory space at our disposal. There is a very great need for more laboratories. This would enable the staff to increase their output without strain.

V. A. BECKLEY,
Agricultural Chemist.

APPENDIX F.

ANNUAL REPORT OF THE ENTOMOLOGIST, 1928

At the commencement of 1928 the staff consisted of one Entomologist with three assistants as shown below.

Mr. T. J. Anderson, Entomologist.
Mr. H. Wilkinson, Assistant Entomologist.
Mr. T. W. Kirkpatrick, Assistant Entomologist.
Mr. H. C. James, Assistant Entomologist.

Mr. James arrived in the Colony on 2nd January on first appointment.

Mr. Kirkpatrick left Mombasa on the 28th March and terminated his appointment with the Department on the 4th July. Every endeavour was made to fill the appointment vacated by Mr. Kirkpatrick but difficulty was experienced in finding a suitable candidate.

Mr. Anderson, Entomologist, proceeded on leave to England on the 14th May and Mr. Wilkinson was gazetted Acting Entomologist as from the 7th May.

Thus from May to the end of the year there were only two Entomologists to carry on the work of the work of the Entomological Section.

Travelling.

10,536 miles were covered by car on Government service : T. J. Anderson, 319 miles, H. Wilkinson, 5,257 miles, T. W. Kirkpatrick, 328 miles, H. C. James, 4,632 miles.

The number of nights spent away from the laboratory on duty were :—T. J. Anderson, 8, H. Wilkinson, 112, T. W. Kirkpatrick, 24, H. C. James, 326.

Correspondence.

This is increasing year by year and during the year 1,883 letters were dealt with.

Routine.

Over 400 specimens of insects, damaged plants, seeds, etc., have been examined.

Nearly 200 dissections of locusts have been made.

More than 100 samples of coffee have been examined for the presence of stephanoderes.

Consignments of plants, seeds, bulbs, etc., for export have been examined and certificates given.

Twelve visits have been paid to the General Post Office and consignments of plants examined.

213 applications for permits to import plants and/or seeds have been examined and certificates given.

An exhibit was prepared for the Nairobi Agricultural Show.

Parcels of coffee beans consigned from Tanganyika Territory to the Nairobi Agricultural Show were examined, samples taken, bottled and sealed, and about 70 exhibits were staged.

These parcels were well packed and great care had been taken to keep the coffee free from insect pests. On being examined two parcels were found to contain living beetles and the parcels were destroyed by burning.

A general meeting on maize stalk borer, held in Nakuru on January 7th, was attended.

The Coffee Planters' Union meetings were attended by members of the staff.

Meeting held in various districts to discuss matters relating to stephanoderes were attended as shown below :—

Ruiru, 10th May.
Upper Kiambu, 8th June.
Kiambu, 13th August.
Ruiru, 15th August.
Thika, 28th August.
Punda Milia, 29th August.

INSECTS OF ECONOMIC IMPORTANCE DURING THE YEAR.

The more important pests are recorded under the crops which they attack.

Coffee.

The outstanding feature under this head is the discovery of *Stephanoderes hampei, Ferr.* attacking coffee in Kenya.

This insect was first observed by the Entomologist in " buni " coffee forwarded during April from a neglected plantation in Kiambu. In this area coffee has been grown for over 30 years and the finding of stephanoderes after so long a period came as a great surprise to the planters generally. Stephanoderes long has been said to be indigenous in Uganda and as far back as 1908, Mr. T. J. Anderson (the present Entomologist) advised Government to formulate regulations then calculated to keep this pest of coffee without Kenya's borders. Exactly twenty years have elapsed since these regulations came into force and the finding of stephanoderes for the first time in Kenya.

The question at once arises " How has stephanoderes been introduced? "

Has the beetle escaped from coffee in transit along the railway? If so, one would naturally expect coffee estates near the railway to be first infested—this is not so.

In the passive distribution of a pest such as stephanoderes, transport becomes a very important factor and one begins to think of the possibilities of its introduction by motor transport. If it has been introduced by this means how is it that stephanoderes has appeared simulaneously over wide areas in widely separated districts?

If not introduced in this way there is the possibility of its introduction by the small trader, for example the Indian and Somali, whose practice it is to carry small samples of buni coffee from one estate to another. Such traders cover wide areas and travel from country to country in their efforts to buy this class of coffee. It is therefore easy to understand how pests may be possibly distributed in this way.

There is a possibility that stephanoderes is indigenous. If indigenous, how is it that the beetle and damaged coffee beans have been found only recently? Coffee beans passing through coffee cleaning mills are subjected to close scrutiny and many coffee estates where stephanoderes is now to be found have been thoroughly inspected several times in the past without the beetle or its damage being noticed.

Such questions as the above probably never will be satisfactorily answered.

The serious potentialities of stephanoderes as a pest of coffee are too well known to coffee growers to need recapitulation here, but it should be known that from the moment stephanoderes was found within the Colony no time has been lost in an attempt to devise ways and means for the control of this insect pest.

On the particular estate where infection first was noticed all coffee trees were cut down and burned, the whole plantation cleaned up generally and coffee in store fumigated. Steps were then taken to make a rapid inspection of coffee estates in the surrounding district and Mr. F. B. L. Butler, Grader and Inspector, was removed from his duties at the Coast to do this work.

During July some seventy coffee estates were inspected, seventeen of which were found to be infected with stephanoderes and many more were suspected. Owing to shortage of staff further inspection could not be undertaken at this time.

A bulletin on stephanoderes was published by the Department. Meetings with coffee planters were held and information re stephanoderes was given. Draft stripping rules were drawn up and these, together with other suggested methods for control of stephanoderes were discussed by the Senior Coffee Officer and coffee planters so as to arrive at the best methods of control without involving unnecessary hardships. They were gazetted on 27/12/28 (Government Notice No. 674).

To administer these rules a temporary staff of some 16 inspectors and assistant inspectors working under the direct control of the Senior Coffee Officer are to be appointed. Government has made a special grant of some £5,000 to carry out what is termed a stephanoderes campaign. These inspectors with their assistants (after receiving preliminary training in entomology, mycology and plantation inspection) are to make a systematic inspection of all coffee estates within the Colony.

There is no doubt that the above rules will have to be modified as experience is gained but it is hoped that this campaign and the prompt measures so initiated will prove efficacious in the attempt to control *stephanoderes hampei.*

Life History.

It was not possible to obtain sufficient material during the year to carry out life history work as desired. In the laboratory where experiments were conducted not one individual female could be induced to lay eggs.

All stages including eggs, larvae, pupae, male and female beetles were isolated from material collected in the field. Without knowing the exact dates and times of appearance of these stages, observations after isolation indicate that the duration of the egg, larval, and pupal stages is longer than similar stages in Uganda and that the length of life of the adults is shorter.

Mealy Bug (Pseudococcus lilacinus, Ckll. the common coffee mealy bug).

This is still the most important pest of coffee. Owing to shortage of staff it has not been possible to continue the research work done by Mr. Kirkpatrick. Planters have continued to use " Cresoto " in a manner detailed in Bulletin No. 18 by Mr. Kirkpatrick, but with varying results. Much more research work is needed before satisfactory control measures can be advocated.

Longicorn Beetle.

Of 103 samples of " buni " coffee forwarded to be examined for the presence of stephanoderes 58 were found to show a type of damage since proved to be caused by a longicorn beetle not yet named. The type of damage is very typical and unlike

that produced by any other pest of coffee so far observed. Both the larva and the adult beetle destroy the tissues of the bean.

The larva usually commences to attack a coffee bean along the longitudinal furrow. The tissues along this furrow are so destroyed that when about half eaten the bean appears boat-shaped. When food is plentiful the adult often leaves a bean half destroyed to commence its attack on other beans. At other time the beans are so completely eaten that nothing but an empty shell of parchment with a few holes in it is found within the hard coffee berry. The exit hole in the berry is slightly oval, almost circular in shape, and varies in size according to the size of the emerging beetle. The diameters of the holes vary between 3 to 4 mm. wide and 4 to 5 mm. long.

So far no eggs of this beetle have been found but there is little doubt that the eggs are laid outside of the berry and that the young larva enters the beans by first boring through the coffee berry, making a small hole about 1 mm. wide and 1½ mm. long. In most cases the adult beetle emerges by enlarging the small entrance hole made by the larva. In only a few cases have two holes, a small entrance hole and a large exit hole, been observed in the same berry.

Pupation takes place within the coffee bean and no cocoon has been observed.

In no case could a larva or an adult beetle be induced to attack green coffee berries or soft coffee beans.

Only the hard black berries are found to be attacked by this insect. In a few instances the larvae and beetles have been noticed attacking the hard black berries still remaining on the coffee bushes.

Antestia.

In Songhor, Muhoroni, Fort Ternan, Timboroa and Turbo districts, antestia has been more prevalent during the year and is reported to have caused considerable loss of crop due to "berry fall."

The life history of this insect, and the control methods are dealt with in Bulletin No. 1 (by T. J. Anderson) issued by this Department and in Bulletin No. 13 (by H. Wilkinson) issued by the Department of Agriculture, Uganda.

Since these bulletins were issued many planters have controlled antestia by using a poison spray of the following composition :—

Arsenite of soda, ¾ oz.
Jaggery or coarse sugar, 2½ lb.
Water, 4 gallons.

In wetter districts the arsenite of soda has been increased to 1 oz.

In Songhor, where rains are frequent, the use of this poison spray in the form of a fine mist appears less effective and the Senior Coffee Officer suggested that the spray should be applied directly to the main stem. This has met with more success but is not completely successful. It is also reported that the scelionid parasites of antestia eggs are not present in these areas. Efforts were made to collect parasites from the Kabete and Limuru districts and during the month of June boys were out in these areas collecting parasitised eggs. The number obtained was so few that breeding of parasites for liberation in the field in the above-mentioned areas was impossible.

Metadrepana andersoni, Tams.

In the Nyanza Province the larvae of this moth defoliated some 700 acres of coffee. The larvae are easily destroyed by spraying the coffee bushes using 3 lb. lead arsenate powder to 100 gallons water.

Dr. James, Assistant Entomologist, has written the following notes on his work during the year :—

" The life histories of the white and yellow borers have been sufficiently investigated to enable new or improved control measures to be recommended. It is, however, considered advisable to delay the publication of illustrated bulletins until a complete account of their bionomics can be given.

The following summary may be useful to those who have been unable to obtain the above bulletin.

White Borer (Anthores leuconotus, Pasc).

The bulk of the beetles are in flight during the short rains. Temperature seems to be the chief factor which affects flying power. In the early hours of the morning the beetles are quite torpid and easily caught by hand but later in the day under the influence of strong sunshine they are capable of strong flight. They are exceedingly skilful in concealing themselves under the foliage and are not easy to find unless in considerable numbers. Hence handpicking will not give results unless the beetles are in considerable numbers.

The beetle possesses a characteristic habit of gnawing the green bark of many internodes of the coffee plant. This type of damage is often a useful indication of a coming attack.

Eggs may be laid in the bark in three quite different situations.

In the great majority of cases the eggs are laid on the main stem about ground-level. Larvae from eggs laid in this position develop the most dangerous type of attack for the resulting ringbarking of the stem and decortication of the tap root speedily kills a tree.

Eggs may also be laid much higher up on the main stem or even on the primaries. Since the larvae in these cases never descend to the roots the damage is not so serious. Two- to three-year-old trees are most usually attacked. The egg hatches into a small, white, footless and somewhat flattened grub which bores down between the bark and the wood, making a passage which is filled with the characteristic long frass strands of the larva. As the larva grows it begins to bore into the wood after ringbarking the stem several times. The more mature grub becomes cylindrical in shape and assumes a pale yellow colour.

The pupal or chrysalis period lasts from 38 to 42 days. When the beetle escapes from the tree the latter is usually quite dead.

The best method to control this pest is to destroy the grub *in situ* while it is still small and its damage insignificant.

This can be done most effectually by applying friction to the bark of the stem for two or three inches both above and below ground level. This treatment causes the bark severing the larval passage or passages to come away thus revealing the characteristic long frass strands produced by the grub.

Care must then be taken to catch and destroy the young grub. This should be easy since its movements are slow and its burrow in the wood is very shallow at this stage.

A short length of fairly thick wire recurved at the business end will be found suitable for destroying grubs in more advanced stages which have bored some distance into the wood.

The best time in Kenya for the performance of this operation appears to be January and February. The lower the altitude the earlier the work should be undertaken. At 4,000 feet the task should certainly be undertaken in January, whilst at 5,000 feet February would probably be more suitable.

The writer does not recommend the use of chemicals such as vermikol, etc., for insertion into the burrows to kill the grub as a great deal of unnecessary harm is thereby done to the tree

Moreover such treatment is expensive and has no corresponding advantage over mechanical methods of destruction, *e.g.*, by the use of a length of recurved wire.

The Yellow Borer of Coffee (Dirphya princeps, Jord.)

The yellow borer beetle is on the wing at the beginning of the long rains. Eggs are laid usually in the lateral branches a few inches from the tip. The female bites a hole in the green bark and deposits one egg therein. The young larva bores into the stem and then along it following the general direction of the cambium.

In general appearance the larva resembles that of the white borer but is more active and of a bright orange colour with brown markings on the pronotum.

On reaching the main stem the larva continues to bore downwards sometimes even below ground-level into the roots.

From its vertical passage the larva excavates small circular horizontal passages about 1 to 2 mm. in diameter at frequent intervals. This gives an infested stem a characteristic ' shot holed ' appearance.

These horizontal holes are used for the extrusion of frass.

The larva reaches the ground-level about July and August in Kenya. Towards the end of the year the larva pupates at the base of the vertical burrow in a cell constructed of frass to protect itself against marauders.

The life cycle occupies about a year.

The best method of avoiding serious damage from this pest is to cut off and destroy infested primaries before the grub has reached the main stem. Evidence of attack is afforded by the presence on the ground of the characteristic frass which resembles small cork borings.

The best time to look for this type of damage in Kenya is during the months of April and May. If, however, the grub has succeeded in reaching the main stem it should be destroyed by chemical means, as it is difficult to find by excavation owing to the length of the burrow and serious damage may be done to the tree. The burrow of the grub should be traced backwards to the primary from which it originated. Now cut off the primary near its base and plug up all the exits of the lateral burrows with clay or putty. Then pour carbon bisulphide (CS_2) or kerosene down the burrow at the point where it entered the main stem from the exised primary and plug up the entrance to the burrow.

Root Mealy Bug (Pseudococcus citri, Risso.).

Some experiental work was done on the mealy bug which lives on the roots of coffee in association with a fungus. It is a somewhat serious pest in Uganda but has not yet caused much loss in Kenya.

Root mealy bug so closely resembles the common coffee mealy bug (*Psedococcus lilacinus, Ckll.*) that it was deemed advisable to test whether the root form was capable of adapting itself to the subaerial mode of life adopted by *P. lilacinus.*

Infection experiments showed, however, that root mealy bug could not make use of the subaerial parts of the coffee plant as food and is not capable of forming a source of infection for the propagation of the common coffee mealy bug.

Scale Insect Pests of Coffee.

Research was also begun into the bionomics of *Asterolecanium coffeae, Newst.*, the fringed scale of coffee.

Owing to working in an exceptionally favourable field the basis of the investigation has gradually been widened to include all the scale insects of any importance which attack coffee in Kenya.

Asterolécanium coffeae, Newst. (The Fringed Scale of Coffee).—The following notes on this most dangerous pest appear to be of special importance.

Owing to its low reproductive capacity and also because it is practically unattended by ants, asterolecanium is a relatively slow spreader. Once firmly established, however, it is easily the most difficult scale pest of coffee to eradicate for the following reasons.

1. The scale imbeds itself in a deep depression on the green bark of the tree thus increasing its resisting powers to insecticides.

2. The hard test or shell surrounding the mother scale surrounds and protects the developing eggs. These eggs hatch after the insecticides have disappeared.

3. Present knowledge suggests that predators and parasites do not cause a high mortality among the scale.

It is imperative, therefore, that a slight attack should receive immediate and continuous treatment until the trees are clean.

From the study of the life history the best time for treatment is immediately after the rains. At this time great reproductive acitivity occurs among the scales present on the older bark of the tree. This is followed by a great exodus of the mobile forms from the old bark on to the young green shoots.

These mobile forms or nymphs are about 0.30 mm. long, roughly oval in shape and of the same yellowish colour as the adult scale. When these young forms find a desirable site they moult their legs and fix themselves to the bark of the tree.

The favourite place for fixation is at the nodes of the young stems near the base of a leaf petiole. By means of their long tubular mouthparts they succeed in obtaining practically all the food intended for the leaves, which of course soon turn black.

If an infested tree is neglected it finally becomes completely encrusted with the scale despite a partial periodic abeyance during the rainy seasons.

The spread of the pest is brought about in the mobile stage already referred to.

The mobile forms are only capable of travelling about one metre in five hours but the wind and cultural operations no doubt assist dissemniation. In the case of a very heavy infestation the stumping and burning of the infected trees is probably the best remedy. The stumps should afterwards be scrubbed with a strong contact insecticide and then limewashed after the suckers have come away. The suckers afterwards should be closely watched for a possible reappearance of the pest. Where the infestation is not severe stumping would appear to be too drastic a proceeding, especially over large areas.

In cases of this kind, asterolecanium should be got under control by the thorough scrubbing of infested trees with a strong contact insecticide. The writer has found the proprietary spray called ' Agrisol ' diluted ten times and applied with a stiff handbrush, to be quite effective, but other sprays should prove equally useful.

This treatment should be repeated at intervals of about a fortnight if necessary until the trees are completely clean.

Even a little scorching of the foliage should be lightly considered when weighed against the complete supression of this tenacious pest. Infested green shoots should be judiciously pruned and the prunings collected and burned. If possible, operations against asterolecanium should never be undertaken immediately before the rains. At this time the pest is in its most active and least vulnerable phase and parasitic and pedatory activities are at their maximum.

Four species of internal parasites of asterolecanium have been found but the incidence of their infestation does not appear to be high. The most promising of its predaceous enemies yet found is a minute and sometimes very numerous species of ladybird.

Green Scale (*Lecanium viride*).—After asterolecanium, green scale is probably the most potentially dangerous scale pest of coffee in the Colony. Unlike asterolecanium it secretes a large amount of honey dew and is very well attended by ants.

Its danger lies in its very great reproductive powers combined with only a moderate degree of parasitic infestation.

Up to date only four species of internal parasites have been obtained.

Waxy Scale (*Ceroplestes ceriferus*).—The work so far done on this scale leads one to believe that it will never become a serious pest of coffee in Kenya.

Compared with asterolecanium it has a high reproductive capacity, its mobile forms are more active and it receives very close attention from ants. It is, however, probably the most highly parasitised scale pest of coffee in this country.

Seven species of its internal parasites have been found and more will certainly be obtained.

Black Scale (*Saisctis nigra*).—This scale is also highly parasitised and need not be seriously considered by coffee planters. Six species of internal parasites have been bred out from it, one of which has a very high percentage of infestation.

Unfortunately at least one hyper-parasite has been found.

Like waxy scale it is very well attended by ants and has great and rapid breeding powers.

Brown Scale (*Lecanium haemiophericum*).—Not much work has yet been done on this scale, but one species of internal parasite has been obtained from it.

New Pests.

1. A species of cicada has been found damaging coffee in the Kakusi district. These large bugs rest on the main stem or primaries and suck the sap after puncturing the bark with their piercing mouthparts.

2. An undetermined species of stem-boring beetle attacking coffee.

Acknowledgement.

I desire to take this opportunity of thanking all coffee planters whom I have visited for the readiness with which they have co-operated with me where necessary in my work."

Maize.

Stalk Borer (*Busseola fusea Fuller*).

In order to control this pest every endeavour was made to see that Maize Rules were carried out in the administrative areas of Nakuru and Ravine. Owing to the drought of 1927 harvesting commenced early and due to the late appearance of the long rains of 1928 planting did not commence until late in March. This gave a longer period during which there were practically no maize stalks standing in the ground and consequently food of the stalk borer was scarce.

So complete was the destruction of maize stalks after harvesting that only two estates in the above administrative areas had stalks remaining when planting commenced. Much of the first planted maize was destroyed by cutworm and armyworm species (?) and replanting became necessary. This resulted in the latest date for the planting of maize being changed from June 10th to June 30th.

During the maize season stalk borer was scarcely in evidence and on September 26th the Maize Rules were temporarily revoked. The success with which the stalk borer campaign was carried out was largely due to the untiring efforts of the inspectors to see that all maize stalks were dug up by the roots and burned immediately after harvesting.

Cutworm and armyworm.

These insects were much in evidence in certain areas and their attacks resulted in almost complete destruction of crops necessitating extensive replanting of maize. In these areas the spreading of poison baits and other recognised methods of control appear to exert little control over such pests as cutworms and armyworms.

Much useful work could be done if only sufficient staff was available to allow of research work being conducted on these pests.

Wheat.

Individual farmers of this crop have suffered very heavy losses as a result of attack by flocks of birds. One farmer alone estimates his loss at 4,000 bags of wheat.

From one block of 90 acres it was estimated that 1,000 bags would be reaped. Birds descended in thousands and attacked the wheat to such an extent that only 64 bags were reaped from 60 acres and so little grain was left on the remaining 30 acres that it was left unharvested.

Certain settlers who have farmed in the Colony for a long number of years gave it as their observation that wheat, barley, etc., are only destroyed at a considerable extent when the ripening of these crops fails to coincide with the ripening of the seeds of wild grasses. This observation is well worthy of investigation.

Locusts.

(*Schistocerca* (*gregaria, Forsk*), (*peragrina, Oliv*).)

During the year these insects have been present over very large and widely separated areas within the Colony and have caused considerable loss of crops both to Natives and Europeans. The size of some of the swarms has been enormous, measuring some sixty miles long by three miles wide.

An account of the activities of the Department during the present campaign will be found in the report of the Deputy Director of Agriculture.

The writer was posted to the Meru-Isiolo area to make observations on the insects in the concentration there during 1928.

Observations.

The moment a locust becomes adult after the fifth moult it is very soft and flabby. The insect gradually becomes harder and firmer, taking some three to four days to become really firm. This change in consistency is accompanied by a colour change. The general colour of the body of a newly emerged imago, the legs, and especially the middle and front pairs, is slate or grey-blue, almost black, and the face is blue in colour. Along the side of the abdomen and running the whole length is a narrow white line, and at the base of each abdominal segment is a white band. The spots on the carapace are yellow on a black background.

As the insect hardens it gradually becomes dark red in colour. After some eight weeks this colour has gradually changed to a bright red. Then the colour gradually changes to that brilliant lemon yellow so characteristic of the mature male locust. The yellow colour first appears at the end of the dorsal surface of the abdomen and the hind tibia, then the hind femur, the base of the wings, and the upper surface of the abdomen from the tip forwards. The middle and front pairs of legs and the hind legs are the last to assume the yellow colour. It should be noted that the female locust is never so completely yellow in colour as the male. The mature female, containing developed eggs, has the abdomen pale slate-blue in colour with the middle and front pairs of legs appearing as though the blue colour had been washed out, the hind legs, head, wings and upper surface of the abdomen are yellow, as in the male. At this stage the abdomen elongates to about $1\frac{1}{2}$ times its original length.

With these colour changes are correlated changes in the development of the actual organs. But not until the abdomen of the female assumes this pale slate-blue colour and the colour almost disappears from the middle and front pairs of legs are the eggs fully developed. The period between the last moult and the deposition of eggs would appear to be from $3\frac{1}{2}$ to 4 months.

When a swarm of locusts is mature and the females are ready to lay, the swarm scatters and may split up into several minor swarms which remain in the same vicinity. At this time the locusts are never so thick on the ground as at other

times and a greater area is covered by the same number of individuals. This period is marked by the fact that each female has a male locust clinging on to its back and each insect remains parallel to the other in any position, even when disturbed and the pair fall on to their sides. It is the popular opinion that copulation is taking place, but this is not so. It seems reasonable to believe that it must be much easier for the female to force her abdomen deep into the soil when she has the added weight of the male than when left to her own resources.

The female when laying extends her abdomen to an incredible length and forces this into the soil. Having reached the required depth she commences to deposit her eggs in successive rows of four to five in a row, the eggs in one row overlapping those in the next, the whole being cemented together in a packet with froth. When all the eggs are deposited the hole is filled up with froth which is spongy in consistency and looks like isinglass.

After the froth has dried the whole egg packet can be removed intact from the soil. As the female removes her abdomen from the soil a hole is left about 6-7 mm. in diameter open to the surface. The first shower of rain soon obliterates such obvious signs that laying has taken place.

Eggs are deposited at various depths, though usually about 3-4 inches. Packets of eggs have been observed at a depth of 5 inches. This seems incredible when the ordinary length of the abdomen is about only 1½ inches long. The egg packets vary in size but may be as much as 2½ inches long. Each packet contains from 40 to 110 eggs. The froth which fills up the hole containing the egg packet as never been observed to reach the surface. This froth sometimes extends to a depth of two inches. Where egg laying had taken place in tufted grass country it was noticed that most of the egg masses were deposited close to each tuft of grass, fewer egg masses being deposited in the more open places.

When laying, the female often was noticed clinging to these tufts of grass and working her abdomen into the soil. This may be a question of obtaining greater purchase.

Hatching of Eggs.

It is generally stated that eggs do not hatch until after they have been wetted by rain. According to my own observations eggs have hatched over wide areas without rain having fallen subsequent to the eggs having been deposited.

The period between egg laying and the appearance of young hoppers varies according to such conditions as altitude, temperature and perhaps moisture content of the soil.

Twelve days at 3,300 to 3,400 feet is the shortest period I observed.

H. WILKINSON,
Acting Entomologist.

APPENDIX G.

ANNUAL REPORT OF THE MYCOLOGIST FOR 1928.

Staff Changes.

Mr. F. W. Evans, Junior Laboratory Assistant, was absent on leave to England from 20th April till 14 November. Mr. A. S. M. Gilfillan, Junior Clerk, performed the clerical part of Mr. Evans' duties from June 12th till November 1st.

Travelling.

Approximately 4,600 miles were covered on Government duty. The chief journeys undertaken were as follows :—

March.—To Eldoret, for the Agricultural Show, and to North Lumbwa and Fort Ternan to investigate the reported occurrence of mosaic disease in sugar cane owned by squatters in those districts.

June.—To Kibos, Miwani, Kibigori, Muhoroni, Koru and North Lumbwa in connection with the campaign to eradicate sugar mosaic disease. To Trans Nzoia where a general tour in connection with crop diseases was carried out.

October.—To Miwani, Nandi Escarpment and Kaimosi accompanied by the Mycologist (Dr. Storey) and Soil Chemist (Mr. Milne) of the East African Agricultural Research Station, Amani. This tour was carried out partly to show the visitors some of the problems to be met with in sugar and coffee cultivation in Kenya and also to investigate the position with regard to coffee berry disease reported not long previously from Nandi Escarpment area.

November. To Njoro to inaugurate some wheat rust experiments at the Plant Breeding Station there.

December.—To South and Central Kavirondo to report on measures taken to eliminate varieties of sugar cane susceptible to mosaic disease in Kabondo and Alego locations.

Correspondence.

Inward letters numbered 762; outward, 540.

Enquiries from settlers concerning disease in cultivated crops covered a range of 27 hosts. More than a quarter of this correspondence dealt with coffee. A larger number than usual of requests for identification of botanical specimens was received. The specimens included mainly pasture grasses, injurious weeds or suspected poisonous plants.

Other correspondence dealt with matters connected with plant importations and exports and the sugar cane mosaic eradication campaign. In addition communication was maintained with mycologists and others, interested in problems having a bearing on those existing in Kenya.

Investigational Work.

Wheat.

Energies during the year have been concentrated on problems connected with stem rust of wheat (*Puccinia graminis tritici*). As briefly mentioned in my Report for 1927, this work was begun last year on my return from leave in England.

The Plant Breeder, in the course of his work in the past, had produced a number of new hybrid wheats, some of which proved consistently resistant or susceptible in successive years while others varied in their behaviour in different seasons. It seemed possible that this variation in resistance might be explained by the presence of different physiologic forms of stem rust, the wheats which had shown variations in their behaviour being resistant to some of them and susceptible to others. If the presence of such forms in Kenya could be proved, the old idea, held by some, that a wheat variety, which had remained rust-free for a number of years and had then been attacked, had suffered a break-down in resistance, would be disposed of. A variety, moreover, which proved resistant to all the physiologic forms existing in the region in which it was grown, should never show such a break-down in resistance. An investigation of this problem was therefore begun, a number of pure-line selections having by this time become available for the purpose.

In order that the nature of the work carried out may be more fully understood, some further explanation is necessary. It is probably generally known to wheat farmers in this country that three different *species* of rust attacking wheat exist in Kenya, namely stem rust, orange leaf rust and yellow rust. Of these, stem rust, so-called because it is the only one which affects the stems seriously, is the most generally destructive, and it is with this species that these investigations have been exclusively concerned.

The above-mentioned rusts are all quite distinct from one another and can readily be distinguished by means of certain characteristics visible to the naked eye and by others discernible under the microscope. Certain American investigators, however, were the first to show that wheat stem rust contains a number of strains within the species which, while quite distinct from one another, cannot be distinguished either by the naked eye or (except by laborious methods) by means of the microscope. These strains are what are known as "physiologic

forms." They differ from one another in the degree of infection which they are capable of producing on different wheats inoculated with them. Thus one physiologic form, when a particular variety of wheat is inoculated with it, may produce numerous large rust pustules, indicating that the wheat is susceptible to it. On another wheat, the same form may not be able to form pustules at all or may only produce very small ones, the wheat thus proving highly resistant to attack by it. With another form of rust on the same wheats, the reactions may be reversed so that it becomes obvious that the two rust forms are not identical. In the same way, by employing a larger range of wheat varieties, inoculating them with stem rust from several sources and accurately observing the reactions produced, it may be possible to distinguish further physiologic forms. Thus, by this method, about forty different physiologic forms of stem rust have been shown to exist in America and these have been distinguished from one another by the different degrees of resistance or susceptibility exhibited by a series of twelve wheat varieties when inoculated with them. These twelve varieties are spoken of as " differential hosts." One of them is highly resistant to all the American rust forms while another is consistently susceptible to them, the remaining ten exhibiting varying degrees of resistance or susceptibility to dfferent groups of rust forms.

In order to discover whether more than one physiologic form occurs in Kenya, it was first of all necessary to obtain a large number of wheats, to inoculate them with rust from as many districts as possible and to compare accurately the reaction obtained on each wheat with rust from each district.

For this purpose, therefore, a number of locally grown wheat varieties, several of the Plant Breeder's hybrid selections and the full range of the American differential hosts, have been submitted to artificial inoculation with stem rust obtained from different parts of Kenya. Tests have been made during the year with stem rust obtained from the following ten districts : Nairobi, Machakos, Nanyuki, Aberdares, North Kenya, Njoro, Molo, Burnt Forest, Soy and Kitale. These included two rust collections from Nairobi and three from Njoro, made at different times of the year. Over forty separate experiments, involving several thousand inoculations, have been carried out.

Most of the wheat varieties used reacted in the same manner with the rust from all the districts, that is to say each variety was either consistently resistant or consistenly susceptible. Four varieties in particular, however, showed marked differences when inoculated with rust from certain districts, the same wheat proving in some cases resistant, in others susceptible. These four wheats thus acted as differential hosts and repeated experiments with them have in consequence

proved conclusively the existence of at least two distinct physiologic forms of stem rust of wheat in Kenya. For the sake of convenience these two forms have been designated K1 and K2. Of the four wheats which have been utilised as differential hosts, only one, Einkorn, is also used in America. Each of the other American varieties has reacted consistently in the same way to both the forms so far discovered.

Kenya Governor was also one of the wheat varieties used as a differential host, a fact which is interesting in view of past field experience with this variety. It has proved highly resistant to one of the forms but it is moderately susceptible to the other. It will be recalled that Kenya Governor has generally proved a safe wheat to grow in this country but that there have been one or two districts where, in certain seasons favourable to rust, it has been considerably attacked. This can now be explained on the assumption that in those districts and seasons, Kenya Governor encountered the particular physiologic form of rust to which it is not resistant.

Of the two forms so far discovered, K1 has occurred up to the present much more frequently than the other. It has been found in seven out of the ten districts, while form K2 has been found in three districts only.

In the course of these investigations another important fact has been demonstrated. It has been found that the same physiologic form does not necessarily occur in the same district each year. Thus the rust at Nairobi towards the end of 1927 was form K1, while that collected there in July, 1928, was form K2. A similar experience was met with at Njoro, and moreover, in the case of the latter district, experiments in hand at the end of 1928 indicated that a form was present in November different from that found there two months earlier.

The knowledge that two physiologic forms of stem rust occur in this country is of immediate practical application. It is now possible to maintain cultures of the known forms at the laboratory and, by submitting new selections of wheat to test by inoculation in the seedling stage, to gain a considerable amount of information as to the degree of rust resistance which they possess to each form. It is of great value to the Plant Breeder to have such knowledge, as it enables him to discard at an early stage those selections which do not exhibit a promising degree of resistance. The work, however, involves considerable time as each test takes about a month to carry through and it is necessary to inoculate each wheat with each form separately. If more forms are discovered it will be necessary to test with them also. Already, however, many hybrid selections have been tested with one or both forms and in the case of one of them the reactions of about fifty varieties to it

have so far been determined. In this connection, it may be of interest to mention that seedlings of the new variety, B. 286, have proved highly resistant to inoculation in each case. It is proposed to continue the work of testing selections already in existence with these forms, and to make it a routine practice in the case of hybrids which may be produced in the future.

In concluding this section of my Report, I should like to acknowledge the co-operation and assistance which I have received from the Plant Breeder (Mr. G. J. L. Burton) in collecting rust samples in the various districts he has visited and in helpful discussion on points that have arisen from time to time.

Sisal.

The leaf injury of sisal mentioned in last year's report, and two other manifestations of a similar nature have been the subject of investigation at different times of the year.

Type A.

At the beginning of the hot season, about the end of February, reports of a leaf injury were again received from Thika. A visit was made to an affected estate and it was found that leaves which appeared perfectly sound before cutting were arriving at the factory in various stages of injury. The trouble was confined to the upper halves of the leaves and showed the following progressive stages. Large patches of tissue first turned purplish-brown. These areas then grew paler in colour and, after passing through various shades of brown, became completely bleached in a few hours. Thereafter, in the course of a varying number of days, the bleached areas turned partly or wholly black and, in many cases, the fructifications of the fungus *colletotrichum agaves* developed on the blackened portions. With the passing of the original purplish-brown stage, the surface tissues of the leaves became sunken and ridged longitudinally and from this point onwards clean decortication proved impossible.

The rapidity with which the initial changes took place appeared to rule out the possibility that the trouble was due to the fungus although it was probably the cause of the final blackening. Certain theories, however, suggested themselves and were afterwards tested at the laboratories.

It was found that :—

(*a*) The symptoms could be produced by merely placing freshly cut leaves flat on a bare roadway in contact with the soil on a hot day.

(*b*) The injury did not occur when the leaves were raised an inch or so off the ground, although still kept in a horizontal position, exposed to the full effects of

the sun's rays, nor were they damaged when placed vertically with the butts on the ground and the tips together.

(*c*) The injury could not be produced on a somewhat overcast day when the soil surface temperature did not rise above 42° C.

(*d*) Shading the leaves by means of a board placed over but not touching them as soon as they were placed on the hot ground, reduced the injury to insignificance. Under these conditions a rapid fall in the temperature of the soil surface was effected.

The conclusion was reached that the injury was caused solely through the contact of the leaves with the soil on exceptionally hot days.

Type B.

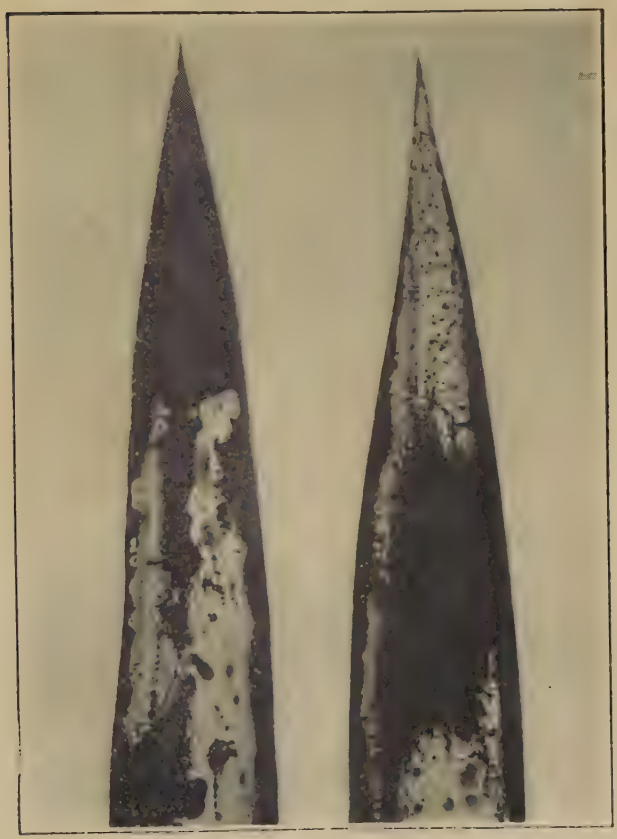
In contrast with the above, a second type of injury was reported from the same district in the cool season in July, when the sky was overcast for much of the day, although no rain occurred, and the mornings were cold and misty, with some dew.

As before, the leaves prior to cutting showed no sign of injury or disease, but afterwards, when tied in bundles of 20 and left a few hours (often overnight) in the plantation, yellow, buff or purplish depressions developed on both sides of a large number of leaves. In the affected patches, green islands of normal tissue frequently occurred. It was found that, except in the early stages of the trouble, successful decortication was impossible.

It appeared from these observations that the phenomenon might be connected in some way with the accumulation of moisture on the leaves, combined with low temperatures.

At the laboratories, while the cool weather still prevailed, freshly cut leaves were laid flat on a roadway and some on a grass lawn. Half of each batch was covered with sacking and the other half was left bare. None of the uncovered leaves showed any injury during the five days during which the experiment was carried on, but slight symptoms developed on the others overnight and in two and a half days all the covered leaves showed the same type of injury as that seen in the plantation cuttings. A large part of the area of both surfaces of all the leaves was thus affected.

Slight though typical symptoms were produced on one or two leaves in a bundle of twenty left on a lawn for three days. No effect was produced on two control bundles, one of which was kept on a raised and shaded verandah all the time while the



LEAF INJURY OF SISAL (COOL WEATHER TYPE)
ARTIFICIALLY PRODUCED.

other was placed on the grass in the evening but removed to the verandah each morning. The weather conditions during this experiment were hardly typical of those prevailing at Thika when the injury was at its height, there being intervals of mild sunshine. Much warmer weather conditions soon afterwards set in and it was therefore impossible to continue these experiments with any hope of success.

Type C.

A third distinct type of leaf injury was investigated in September. In this case bright red, slightly sunken blotches of varying size and shape occurred on young leaves, still in a practically vertical position and still attached to the plant. Examination of the plants showed that the backs or fronts of practically all the affected leaves faced in the same direction. This led to consideration of sun or the prevailing wind as a possible causal factor. The orientation of the blotched leaves, however, did not support the possibility that the wind was concerned but, as they faced east and west, it was concluded that the evidence pointed strongly to the hot afternoon sun as the chief agent involved. The trouble was confined to part of one estate only, so that it may be that some soil factor had possibly produced a susceptible condition in the leaves.

Coffee.

During the cool season of each year, certain estates in Limuru, Upper Kiambu and other districts suffer from a dropping of leaves and berries. This phenomenon was more pronounced than usual in 1928 and in one or two cases a considerable loss of crop was sustained.

Specimens submitted were examined at the laboratory for the presence of any organism likely to be connected with the trouble. No sign of parasitic attack could be detected under the microscope and attempts to isolate a parasite in artificial culture also failed. The conclusion was reached that it was extremely improbable that any parasitic agent was involved.

In company with the Senior Coffee Officer, certain affected estates were visited but the observations made did not reveal any very obvious cause of the trouble. A settler agreed, however, to carry out a programme of experiments in 1929 and a scheme was drawn up by the Senior Coffee Officer after consultation.

The Assistant Agricultural Chemist has also an investigation into the mineral composition of affected leaves in hand and is also carrying out some soil analyses in connection with the matter.

In connection with berry disease inspections during the year, it has again been observed that certain bushes exhibiting marked resistance to the disease exist in various plantations.

Owners have been urged to experiment with the selection of seed from such bushes with a view to establishing a resistant type. It is not known whether a good marketing coffee will result nor whether a comparatively pure strain of coffee bush can be speedily obtained, but it is considered that the possibility of good results warrants the small amount of trouble necessary to make the attempt. Mr. L. A. Johnson's plants from such selected seed suffered a severe setback from thrips early in the year. The writer has been promised, and hopes to obtain, seed from a resistant type of tree in another district for experiment at the laboratories.

In a certain area where berry disease is common, a particular part of a block of coffee was observed to be suffering severely from the disease while, in another part of the same block, less than 150 yards distant, the percentage of infection was quite small. The type and history of the trees was identical in both cases, but a difference in the appearance of the soil was distinctly noticeable. Soil samples were accordingly taken and are in course of examination by the Assistant Agricultural Chemist. It is hoped to obtain some useful clues as to the kind of soil deficiency which may predispose coffee to attack by berry disease.

Barley.

A disease of barley causing an appreciable loss of crop was reported from two or three parts of the country during the latter half of the year. Symptoms connected with the trouble include brown markings on the leaves and leaf sheaths, failure of the heads to emerge or, if they do emerge, abnormal twisting of the awns, and lack of grain. Material was collected and an investigation has been begun. At the end of the year a species of helminthosporium was found to be present and it was thought to be a likely cause of the trouble. Various barley diseases are attributed elsewhere to attack by different species of helminthosporium and the work of isolating the fungus, obtaining its exact identity and determining its degree of responsibility for the disease is therefore being proceeded with.

Routine Work.

Sugar Cane.

In connection with mosaic disease of sugar much inspection work was carried out during the year. Reports of outbreaks in squatter cane on European farms in North Lumbwa and Fort Ternan areas were investigated. The disease was found to be present, although the total amount of cane involved was small, and steps were taken, in co-operation with the Administration and settlers, to ensure destruction of the susceptible varieties. Reports of the occurrence of mosaic disease in

Kabondo, South Kavirondo, and Alego, Central Kavirondo, were also similarly dealt with. During a visit paid to these last-named districts in December, considerable progress in the eradication of the susceptible varieties was found to have been made and no disease was seen in what little remained.

The period allowed for the ploughing out of susceptible canes in the non-native area of Nyanza Province expired on 1st June but an abnormal drought period having interfered with plans for cutting cane, short extensions of time were granted in one or two cases. It will probably be necessary on this account to extend the period during which no cane other than the immune Uba variety may be grown.

During inspections it has been found that in some cases fields now planted to Uba but which previously carried infected cane, still show the presence of rogues of the susceptible kinds. The presence of these is also likely to delay the time when growers can again be permitted to plant whatever canes they wish.

The system of permitting sugar cane importations only on condition that they are grown in quarantine at the Scott Agricultural Laboratories until released as disease free, was inaugurated during the year. Under this system imported canes can be inspected at frequent intervals without the necessity of making journeys to sugar plantations, where moreover it is frequently difficult to find areas for nurseries where suitable quarantine conditions can be imposed.

At the end of the year, the laboratory sugar quarantine contained the following :—

(*a*) A small consignment of Mauritian canes imported by a local firm.

(*b*) The product of a single sett of BH (10) 12 obtained from the United States Bureau of Plant Industry through the courtesy of Dr. E. W. Brandes.

(*c*) A few setts each of the following varieties, kindly supplied by the Uganda Mycologist, Mr. C. G. Hansford :—P.O.J. 213, 2725 and 2727, BH (10) 12, Ba 6032, 11403 and 11569.

Other Items.

The wheat conference was attended in August when a progress report on rust investigations was made to the meeting.

A mycological exhibit was prepared and staged at the agricultural shows held at Eldoret and Nairobi in March and October respectively.

A collection of about 100 botanical specimens was classified and added to the herbarium during the year. These included about 50 collected by Mr. W. Lyne Watt on Mount Kenia. The duplicates of a further collection of over 70 have been sent to the Director of the Royal Botanic Gardens, Kew, for naming.

Importations of plants arriving by parcels post have been inspected at the General Post Office, Nairobi, as usual, and certificates of health have been issued, after inspection, in connection with a number of export consignments.

General Observations and Remarks.

With the possible exception of the barley disease already mentioned, no new disease of importance falls to be recorded during the year. Leaf blight of maize, however, appears to have been responsible for considerable loss of crop in the Trans Nzoia and Uasin Gishu districts, although there seems to be room for doubt whether all the loss for which this disease was blamed was in fact attributable to it.

The presence of coffee berry disease in Upper Songhor and Nandi Escarpment areas was confirmed during the period under review.

Judging from the number of enquiries received, covered smut of barley was more common than usual in 1928.

Yellow rust (*Puccinia glumarum*) of wheat which appeared for the first time at the Scott Agricultural Laboratories in 1927 was not seen there in 1928, so that there still seems reason to hope that it does not find congenial conditions at so comparatively low an altitude.

The following are new records for Kenya obtained in 1928 :—

Citrus. On leaves. Algal leaf spot. *Cephaleuros mycoidea* Karst.

Guava. On branches. Pink disease. *Corticium salmonicolor* B. and Br.

Coffee. On dead stump. *Polystictus occidentalis* (Kl.) Fr.

Indigenous grass. On inflorescence. *Epicl.loe cinerea* (?? Sporobolus sp.) B. and Br.

Wood rotting fungi, on dead twigs or stumps of unknown hosts :—

Sarcoscypha coccinia Fr. var *jurana* Boud.

Tremella mesenterica (Retz.) Fr.

Polystictus obstinatus Cooke.

A flowering plant, parasitic on leguminous crops in the native reserves, was reported in the low Emberre country (2,000 to 4,000 feet). It destroys about 20 per cent. of the crops attacked and is believed to be spreading. The parasite is a species of *Alectra*, probably *A. senegalensis* Benth. This plant belongs to the same natural order (*Scrophulariaceae*) as the well-known Striga weed, parasitic on various members of the grass family. The Alectra weed attacks njahi (*Dolichos lablab*), gram (*Cicer arietinum*) and cowpea (*Vigna Catjang*), but does not attack pigeon pea (*Cajanus indicus*), the only other leguminous crop grown in the district. It is evidently seed-borne as it appeared at the Scott Agricultural Laboratories in a crop of njahi raised from seed obtained from Emberre.

In conclusion it remains to acknowledge the valuable assistance received as usual from the respective directors and staffs of the Royal Botanic Gardens and the Imperial Bureau of Mycology, Kew.

J. McDONALD,
Mycologist.

APPENDIX H.

ANNUAL REPORT OF THE PLANT BREEDER.

This report is considerably larger than my previous ones, as the appointment of an Assistant Plant Breeder and an Assistant Agricultural Officer to the Plant Breeding Services has made it possible to undertake more work, particularly with regard to maize breeding and field experiments, the reports on which are the cause of the increased length of my report. In addition, I have added several appendices giving lists of wheats grown during the year, with notes on their rust-resistance. This is a departure from my usual practice, but it is considered that these appendices will give a better idea than has been given before of the work of the Plant Breeding Services and the results which have been so far achieved.

Staff.

Mr. H. D. Spranger took up his duties as Assistant Agricultural Officer at Njoro Plant Breeding Station on February 6th. For most of the year the staff therefore consisted of :—

Mr. G. J. L. Burton, M.C., B.A., Plant Breeder.

Mr. R. J. Lathbury, M.A., Assistant Plant Breeder.

Mr. N. D. Spranger, Assistant Agricultural Officer.

These three officers were stationed at Njoro.

Mr. R. N. Noble, Junior Laboratory Assistant, was stationed at the Scott Agricultural Laboratories, and a large part of his duties was to look after the wheat-breeding experiments there, as the Scott Agricultural Laboratories are too far from Njoro for me to do more than a portion of the work.

Correspondence.

Correspondence with farmers and others on all matters relating to cereal farming continues to increase, which means a corresponding increase in time spent on such advisory work, as each problem has to be dealt with on its merits. It is hoped that Agricultural Officers will be able to relieve me of much of this work in future.

Lectures.

Informal addresses on cereals and cereal farming were given to farmers at Subukia, Nanyuki, Burnt Forest, Eldoret, Molo, Kitale, Thomson's Falls, and the Njoro Plant Breeding Station.

Travelling.

11,160 miles were covered by car on Government Service :—

Mr. G. J. L. Burton, 6,764 miles.
Mr. R. J. Lathbury, 2,760 miles.
Mr. N. D. Spranger, 1,636 miles.

The numbers of days spent away from the Njoro Plant Breeding Station were approximately as follows :—

Mr. G. J. L. Burton, 140.
Mr. R. J. Lathbury, 70.
Mr. N. D. Spranger, 25.

My travelling consisted of visiting wheat and maize farms, visiting the two Plant Breeding Stations, and in assisting in a preliminary soil survey of part of the settled areas of the Colony made by the Assistant Agricultural Chemist.

Mr. Lathbury's travelling has consisted chiefly of visits to the other Plant Breeding Stations, visits to farms in the Molo and Mau Summit districts, and a visit to the Trans Nzoia in connection with selecting maize plants for resistance to white blight.

Some of Mr. Spranger's travelling was on locust duty and some in connection with crop trials at Lower Molo.

It is hoped that the appointment of District Agricultural Officers in the settled areas will enable me greatly to reduce my travelling and the advisory services undertaken in connection with it. The work done during the travels of the Plant Breeding Staff will be found in other parts of this report.

Rust in Wheat.

In my annual report for 1921 I suggested that there might be several different physiologic forms of stem rust present in this country, and by 1927 there were a sufficient number of pure-lines available of new wheats showing variable degrees of resistance and susceptibility to stem rust to provide material for investigation of the question by the Mycologist, with whom the matter had been discussed in the past. It was considered that such experiments lay more within the province of a mycologist than a plant breeder, and, indeed, if carried to the full limit of their possibilities, they would take up almost the whole time of one man. These experiments have been continued with the utmost vigour during 1928, and a discussion of them will doubtless appear in the report of the Mycologist, with whom I have naturally worked in the closest collaboration. On account, however, of the very important bearing they have on the breeding of rust-resistant wheats, it is proposed to discuss them shortly here, so that any remarks made in other parts of this report about the rust-resistance of certain wheats may be properly understood.

There is no need for me to explain what is meant by physiologic and morphologic resistance of wheats to rust, as this was dealt with in a paper (since published in bulletin form) I read to the Colonial Agricultural Conference held in Nairobi in 1926. Physiologic forms of stem rust need, however, a little explanation here.

Some years ago, it was proved by American investigators that there were different physiologic forms of stem rust on wheat, and they isolated nearly 40 forms. These forms could not be distinguished by the naked eye, nor even sufficiently well by the microscope, but they could be and were distinguished by the way the different varieties of wheat reacted to the different physiologic forms. For the sake of example, let us take a variety of wheat called A, and grow it in two pots, numbered 1 and 2. When the plants are in the seedling stage those in pot 1 are inoculated with stem rust from Njoro and those in pot 2 with stem rust from Machakos. If the seedlings in pot 1 show resistance to the rust from Njoro and those in pot 2 show susceptibility to the one from Machakos, then obviously the physiologic form of rust present at Njoro is different from the one present at Machakos, since the variety of wheat in both pots is the same.

During my travels towards the end of last year and throughout this year I collected rust from all districts from which I thought I could obtain different physiologic forms, and sent them to the Mycologist for test. These districts were Njoro, Nairobi, and Molo in 1927; and Njoro (September), Njoro (November), North Kenya, Northern Aberdares, Machakos, Nanyuki, Nairobi, Soy, Nandi Border, and Kitale, in 1928. In addition, I supplied the Mycologist with a large selection of my new wheats, both rust-resistant and susceptible ones, and also some which had varied in resistance from year to year, on which to test these rusts. His experiments have proved that there were at least two different physiologic forms of stem rust in the country during the period under review, and he has named them K.1 and K.2.

K.1 was found at Nairobi in 1927,
Machakos in 1928,
Njoro (September) in 1928,
Soy (October) in 1928,
Kitale (October) in 1928,
Nandi Border in 1928.

K.2 was found at Njoro in 1927,
Molo in 1927,
Nairobi in 1928.
North Kenya in 1928,
Njoro (November) in 1928.

K.1 and K.2 were found simultaneously at Njoro in November, 1928.

It will be noticed that whereas K.2 was found at Njoro in 1927, K.1 was found there in September, 1928, and all the wheats were exposed to infection by it. This explains why it was, as will be found in the list of wheats in Appendix I, that some of the Njoro wheats varied in resistance to stem rust during 1927 and during September, 1928. Those, the early maturers, which were harvested early in November were not infected by form K.2. A further point of explanation is that where a wheat is only moderately susceptible to a rust form (*i.e.*, its resistance is denoted by the letter "C"), climatic conditions must be favourable to the rust, or it will not cause much damage or appear to any great extent on the wheat.

It must be clearly understood now that when the rust resistance of a particular wheat is stated for any one year in any one place, that probably only one, or at the most two, physiologic forms of stem rust were present, and therefore such a statement must not be regarded as a final pronouncement on the rust-resistance of any wheat. One year's test in the field is not nearly sufficient, and I may say has never been considered sufficient, to determine the resistance of any wheat to stem rust. In the past, wheats have been tested for several years in succession not only in one place but in several districts of the Colony, so that they might have the best chance of being exposed to infection by all physiologic forms of stem rust, and it has been necessary to continue with large numbers of strains of wheat in order that a few might be found resistant to all physiologic forms. Strains of hybrids which have appeared identical in appearance have been kept separate on account of the possibility of differences in resistance to stem rust, and a study of the rust resistance of the wheats in the Njoro list will show the value of having done so.

If the Mycologist can spare the time, it is hoped that this position may now be altered, because if a proportion of the seeds harvested from the F_2 generation plants of crosses are given him he can inoculate the seedling plants arising from those seeds with all the physiologic forms and state which of the F_2 plants are worth going on with and likely to produce a proportion of rust-resistant progeny. When pure-lines are produced he can inoculate them also, and state which are resistant to all physiologic forms. This would obviate the necessity of growing a large number of wheats all over the country for several years.

It appears to me that wheat-growers must always face the risk of new physiologic forms of stem rust suddenly appearing to which the wheats they are growing are not resistant.

It may be stated here that Kenya Governor is resistant to physiologic form K.2, but is moderately susceptible to form K.1. Equator is more or less susceptible to both forms, and when either of them appears at high altitudes, such as during the last two years, Equator will succumb if climatic conditions are suitable for the rust. K.1 appears to have been the form most generally distributed throughout the country in 1928.

A further point of importance with regard to this work is that it is now possible for me to choose wheats, as parents for crosses, which I know to be resistant to all physiologic forms of stem rust so far discovered in the Colony.

Wheat Breeding.

Scott Agricultural Laboratories Plant Breeding Station.

Hybrid Wheats.

At this station (the stem-rust station) 28 families of hybrid wheats were sown. These consisted of 333 cultures consisting of some 50,000 hybrid grains sown by hand. Notes were taken on the cultures and on the plants in them, and some very promising material was found resistant to stem rust this year. The seed culled from the harvested plants will be sown in 1929, and it is expected that some plants will breed true to type. It is hoped that when the time comes for the Mycologist to inoculate wheats from these cultures with stem rust that they will be found resistant to all the more virulent physiologic forms in the country, because they or their parents have probably during the course of the past few years been exposed to infection by all forms, and they have never shown susceptibility. The case of the new wheat called B. 286 can be cited in this connection. During all the years it or its near parents have been grown at the Scott Agricultural Laboratories and this year at Njoro, it has shown itself to be practically immune to stem rust. That is why it has been selected for general issue. The inoculations done by the Mycologist with rust on seedling plants of this wheat this year, showing it to be resistant to all physiologic forms of stem rust so far found in the country, has proved a very useful confirmation of its resistance in the field.

Yield and Rust Trial Plots.

As will be seen in Appendix II to this report, some 40 pure-line wheats were tested for yield and rust, with Kenya Governor as the control. The wheats were sown in triplicate in rod-row plots 18 yards long and 2 feet wide. The rows in the plots were 8 inches apart and 18 grains were sown by hand in each row. In order to separate the plots to prevent any fear of mixing during sowing and harvest, a gap of 8 inches was left between the plots, and, to prevent border effect from the presence of this gap, a row of Golden Ball wheat was sown

down the centre of it; Golden Ball being a durum wheat, and so easily distinguishable from the others. These pure-line wheats are some of the progeny of the original crosses made during the first years of my employment here. That is to say, they represent the progeny of those few hybrid plants which have bred true to type and to rust-resistance sooner than the rest, and which have been considered worth while growing on to this stage.

It is fully realised that this is not the best method of conducting yield trials, but with such a large number of wheats involved it was the only possible way, and is sufficiently good as a preliminary trial and for the information of the Plant Breeder himself.

A few remarks on these wheats will be found in Appendix I.

Also in this appendix will be found a list of durum wheats tested out in similar yield trial plots this year. Some of these had been tried years ago. The control wheat was Golden Ball.

Multiplication Plots.

Some of the wheats sown in the Yield Trial Plots were in sufficient quantity also to be sown in multiplication plots, and a list of these will also be found in Appendix I.

Crosses.

Mr. Noble made the following crosses between wheats and the F_1 generation has been sown during the short rains of 1928 so that the important F_2 generation can be sown during the long rains of 1929 :—

Red Egyptian	x	Pusa 12.
,,	x	B.F_4.3.B.10.V.1.(L).
,,	x	Quality.
,,	x	B.F_4.4.C.15.K.3.(L).
,,	x	B.286.A.
,,	x	B.256.C.3.(L).
B. 286. A.	x	B.256.C.3.(L).
,,	x	Quality.
,,	x	B.F_4.3.B.10.V.1.(L).
,,	x	Kenya Governor.
,,	x	B.F_4.4.C.15.F.4.(L).
,,	x	B.F_2.36.C.1.(L).
,,	x	Pusa 12.
,,	x	Red Egyptian.

Red Egyptian is resistant to stem rust, but has very weak straw and is susceptible to yellow rust. It is not considered a high yielder.

The most important crosses are those made with B. 286. The object is to produce wheats of higher yielding power and possibly of better milling quality than B. 286 as quickly as

it can be done; two seasons a year will be used if the progeny of the crosses are quick enough maturing. B. 286 posseses some excellent qualities such as resistance to all physiologic forms of stem rust so far discovered in the Colony, and also strong straw and close chaff. It is early maturing—about four months. Its yielding capacity, however, is probably about 15 per cent. less than Kenya Governor, and its milling qualities are doubtful, but these will be tested in 1929.

As regards the wheats being crossed with B. 286, those named by a series of numbers (the method of numbering was explained in my last report) are hybrids which have recently bred true to type.

B. 256. C. 3. (L) is a very high yielding wheat with ears like an English Squarehead. It is early maturing. It is not quite sufficiently resistant to stem rust to be issued for general cultivation and furthermore it has very long weak straw. It is probably of good milling quality.

Quality and Pusa 12 are short-strawed good milling wheats but very susceptible to stem rust.

B. F_4. 3. B. 10. V. 1. (L) and B. F_4. 4. C. 15. F. 4. (L) are very susceptible to stem rust, but are otherwise excellent yielders and have strong though long straw.

The crosses on which remarks have been made are the most important ones, and, if the F_2 generation turns out well, the other crosses may be discarded.

Njoro Plant Breeding Station.

At this station (the stem and yellow rust station) 38 hybrid families were sown in the cage. These consisted of 368 cultures consisting of some 54,000 hybrid grains sown by hand. Notes were taken on the cultures and on the plants in them. Some of these families were Njoro hybrids (*i.e.*, had been bred from my original crosses at Njoro) and others were families transferred from the Scott Agricultural Laboratories. These latter had been rust-resistant to stem rust at the Scott Agricultural Laboratories in the past, but took too long to mature for the short growing season in that district. They did very well at Njoro, and were resistant to stem rust this year. They showed signs of susceptibility to yellow rust, but not sufficiently so to prevent them being grown, except in areas where yellow rust is a primary danger.

The Njoro hybrid families in the cage were mostly the result of selections made from amongst my hybrid material with a view to isolating a strain with club-tipped ears from amongst the ordinary Njoro hybrid type which usually has ears with tapering tips. The club-tipped type has been successfully isolated, and often contains one more spikelet on each side of the ear than does the ordinary type.

Many cultures amongst this club-tipped type have bred true to type, and are also highly resistant to stem rust. They will be advanced to the yield trial plot stage in 1929.

In the cage also a very compact-eared and rust-resistant type has been isolated from amongst the hybrid material; it remains to be seen how this type yields.

Control plots of Kenya Governor, Marquis, Equator and Golden Ball were scattered throughout the cage. As far as the eye could tell, there appears to be a great difference between the yielding capacity of the Njoro wheats and the yielding capacity of the control wheats. As far as this quality is concerned the new Njoro wheats appear to be greatly better than any other wheats grown in the Colony, and this observation is confirmed by independent observers, *i.e.*, visitors to the station. Something will be said about their resistance to yellow rust later on in this report, when the experiments at Mau Summit are discussed.

Yield Trial Plots.

In Appendix I will be found a list of wheats grown in yield trial plots similar to the plots at the Scott Agricultural Laboratories. Some eighty of these were pure-line types which have been evolved from Njoro hybrids, and about fifty-five were wheats which had been bred at the Scott Agricultural Laboratories, but which, although many were rust-resistant there, had not proved successful, as they took too long to mature to be suitable for the short growing season of that district.

Mr. W. J. Dawson gave me small samples of what he considered to be pure Golden Ball and pure Bontaar. These were grown in the yield trial plots. The Golden Ball and Bontaar looked very similar during growth, except that the Bontaar had longer straw than Golden Ball. There was a great difference between the grain of the two. Bontaar produced the very large plump grain usually associated with Golden Ball. Golden Ball produced a long narrow grain very much more like the usual durum type of grain.

No attempt was made to grow the Njoro wheats in duplicate, as there were too many of them. Similar wheats were grown side by side in groups mainly with a view to obtaining a preliminary idea as to which of them were so similar that they could be lumped together and so hasten the issue in bulk of new wheats resistant both to stem rust and yellow rust, which are so badly needed at the present time; a little seed of each pure-line can always be kept back for multiplication and issue later on if considered advisable. The crying need now, however, is for the issue of new wheats in bulk to replace Equator at the higher altitudes.

A description of the general type of the new Njoro wheats will be appropriate here.

They are all very similar in type. They differ as to beardedness and beardlessness, red chaff and white chaff, red grain and white grain; there are, in addition, minor differences and quite outstanding differences as regards rust resistance. Agronomically, however, they are all of very much the same type. That is to say they have strong straw and close chaff and the type of ear and grain is very similar. One large series takes about five months to mature, and another six months. If, for example, all the bearded, red-chaffed, red-grained wheats were grown side by side, an inexperienced observer would find it hard to discover any differences between them. Differences in rust resistance are, however, of the utmost importance, and although they might all appear resistant to stem rust in 1927, many might show themselves susceptible in 1928, and others again in 1929 owing to a different physiologic form of stem rust being present in the district in each year. This actually happened as regards 1927 and 1928, and was confirmed a short time ago by the Mycologist, who found that two different strains were present in those two years.

The ears of these new wheats are fairly lax and taper slightly at the tip. They would seem to have the capacity to produce a large quantity of grain and are "large" in appearance. The plants stool well and the straw is strong and usually not too long. They are likely to yield better than Equator, Marquis, Kenya Governor or B. 286. Marquis and Equator were not grown in the yield trial plots, as it was expected that they would suffer seriously from stem rust, and therefore it would not be possible to compare their yielding capacities, as far as yield by weight of grain is concerned, with the Njoro hybrids.

Many of the new Njoro wheats are highly resistant to stem rust and some both to stem and yellow rust. In fact, it may be difficult to improve on some of these wheats except in one respect, and that is in the quality of the grain. The grain is very similar all through the series, but it is suspected, and only suspected, I should say, that the milling quality is not too good. This will be tested during 1929. The grain is large and often plump and at first sight would appear to have a high bushel weight. The fact is, however, that the bushel weight of the different strains is usually between 57 lb. and 60 lb. to the bushel. The grain usually has a sharp humped ridge, tapers rapidly down from the germ end, and does not fill the bushel measure well. This question as to the milling quality of the wheats may be a false alarm; that remains to be seen. Most wheats, including Kenya Governor, had a low bushel weight this year, and it might be due to the very unfavourable growing season. Nevertheless, my own opinion is that the

milling quality of the new wheats is probably not as good as that of Kenya Governor or Equator and the grain of many looks somewhat similar to that of durum wheats, though, fortunately, this durum-like appearance is not found on all of them.

Attached to the lists of wheats in Appendix I is their yield per acre and their bushel weight. Bushel weights have been omitted where there was not sufficient grain to make the test. In looking at the yields it must be realised that there was what amounts almost to a drought from the time of sowing onwards, and that the soil is not particularly good wheat soil. Fairly large variations in yield between similar types in the same group may be due to uneven drying out of the soil during the drought. The plots were purposely not irrigated. It is interesting to note how rust-susceptibility has, in many cases, considerably reduced yields.

The wheats were sown on June 15th. There had been 3.93 inches of rain in April and 5.93 in May, and a quarter of an inch on June 12th, so that there was moisture in the soil at the time of sowing. The most useful rain was 1.31 inches which fell on June 27th, and there were good rains of 5.96 inches in July. After that there was no useful rain on the crop execpt for 1.20 inches during the last five days of August. When heavy rains came at the end of October the majority of the wheats were being harvested. Under the circumstances the yield of some strains was surprisingly good. The yield trial plots were fertilised with ground limestone at a rate of one ton to the acre, and with superphosphate at a rate of 130 lb. to the acre. In a fertiliser experiment ground limestone appeared to have no effect on wheat on this soil. The reason for this was probably not that the soil was not too acid, but that the limestone was not sufficiently finely ground to act—at any rate during the first season or two.

The list of wheats in Appendix I has been divided into the same classes as they were divided into for sowing :

Class I consists of bearded, red-chaffed, red-grained wheats.

Class II consists of beardless, red-chaffed, red-grained wheats.

Class III consists of beardless, red-chaffed, red-grained wheats, the grain being less humped than that of the wheats in Class II.

Class IV consists of bearded, red-chaffed, white-grained wheats.

Class V consists of beardless, red-chaffed, white-grained wheats.

Class VI consists of bearded, white-chaffed, red-grained wheats.

Class VII consists of bearded, white-chaffed, red-grained and late maturing wheats.

Class VIII consists of beardless, white-chaffed, red-grained and late maturing wheats.

Class IX consists of bearded, white-chaffed, white-grained wheats.

Class X consists of beardless, white-chaffed, white-grained wheats.

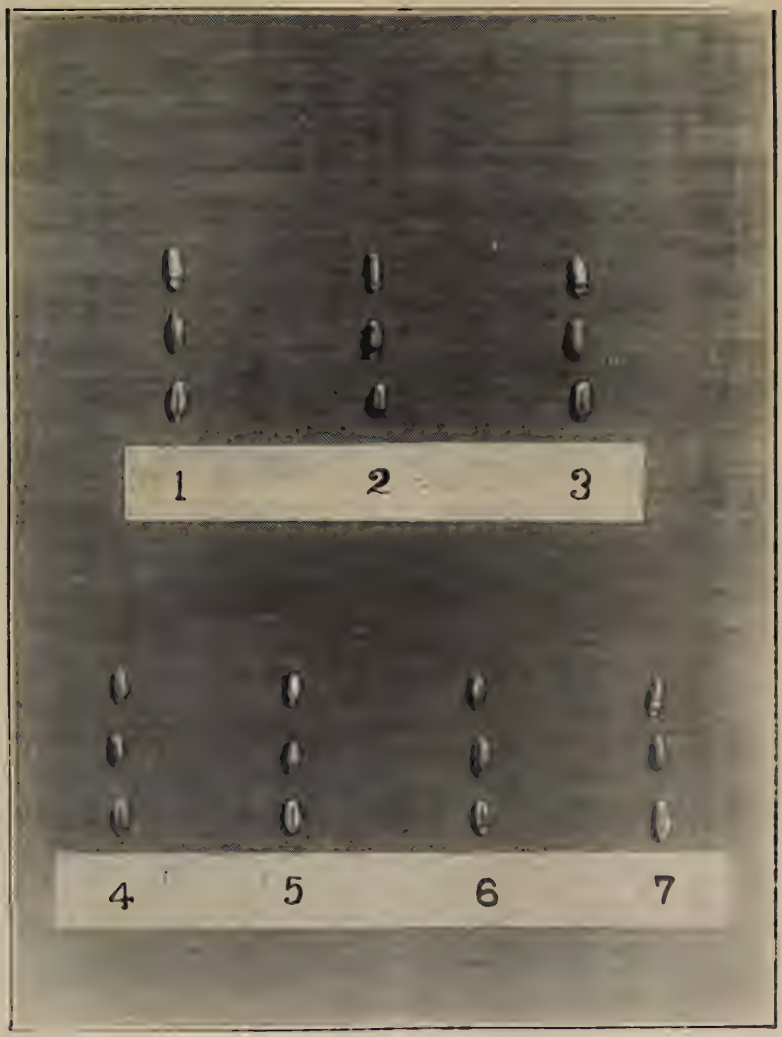
Class XII consists of some oddments and Class XI of compact-eared wheats. The remainder are the wheats transferred from the Scott Agricultural Laboratories.

Notes on the resistance to stem rust of the wheats are given both for 1927 and 1928. Those which were susceptible in 1927 were sown in 1928 as testers for stem rust. It will be found, however, as previously stated, that some wheats which were resistant in 1927 were susceptible in 1928. The Mycologist has shown that a different physiologic form of stem rust was present in 1928 from that present in 1927, and that explains the difference in resistance of the wheats. On account of the unexpected susceptibility to stem rust of some of the later maturing wheats in 1928 it struck me that a different physiologic form might have been present during the latter part of the year from that present earlier. In addition, therefore, to giving the Mycologist samples of rust during September, I sent him some which appeared in November, and I understand from him that he has found that there are two forms present this time, one only of them having been found earlier in the year.

In examining the rust-resistance in the field of the Scott Agricultural Laboratory wheats, readers should remember that the physiologic form of stem rust present at Njoro during the main part of 1928 was the same one which was present at the Scott Agricultural Laboratories in 1927, so that the wheats transferred to Njoro from the Scott Agricultural Laboratories in 1927 should be as resistant or susceptible at Njoro in 1928 as they were at the Scott Agricultural Laboratories in 1927.

This variation in rust-resistance which occurred during 1927 and 1928 has occurred occasionally ever since 1921, and possibly more than two forms of stem rust were involved. It is because of this variation and the possibility of different physiologic forms being the cause that I have had to keep such an enormous number of strains of wheat in existence every year in the hope that some might be found resistant to stem rust every year. The strain imposed on the workers by keeping separate, and continually growing on, so many strains of wheat, hybrids, etc., has been amply justified by the results, in that many new types of wheat have been produced which appear resistant to all the physiologic forms of stem rust so far discovered here. Such wheats would not of course vary

NEW NJORO RUST RESISTANT HYBRIDS R. & L. WITH EQUATOR, CENTRE, INDICATING YIELDING CAPACITY OF NEW HYBRIDS.



Nos. 1, 2, 3, 4, & 7, GRAINS OF NEW NJORO HYBRID WHEATS;
No. 5 KENYA GOVERNOR; No. 6 EQUATOR.

much from year to year in their resistance to stem rust, and were it only such wheats that were being grown it would be very difficult to discover how many physiologic forms of stem rust there were in the country, but some wheats, whose resistance to stem rust varied from year to year, were kept on and are proving very useful now for laboratory work and as rust-testers in the field.

Multiplication Plots.

Some of the wheats sown in the yield trial plots were also sown in multiplication plots. These plots were fertilised with ground limestone and superphosphate. The rusted plots gave very low yields per acre. A curious thing to note is that in some cases where a particular strain of wheat showed resistance in the yield trial plots, yet it appeared susceptible in the multiplication plots.

In addition to the ordinary multiplication plots, a small acreage of B. 286 was grown, an acre of $B.F_2.36.C.1.(L)$, and an acre of what was erroneously alleged to be pure Golden Ball, but it contained an admixture of Nepal barley.

Crosses.

The following crosses were made between wheats ;—

$N.B.F_5.43.A.8.E.7.E.(L.2)$	x	B. 286.
do.	x	Marquis.
$N.B.F_6.42.K.2.G.6.A.23.(L)$	x	B. 286.
do.	x	B. 256. C.3.(L).
do.	x	Marquis.
do.	x	Equator.
$N.B.F_7.43.C.1.U.3.B.13.A.$	x	Red Egyptian.
do.	x	Quality.
do.	x	Marquis.
$N.B.F_4.43.K.2.R.5.(L.2).$	x	B. 286.
do.	x	An English Hybrid.
$N.B.F_5.43.D.2.D.4.A.(L).$	x	B. 256. C.3.(L).
do.	x	Equator.
do.	x	Barwang.
$N.B.F_5.43.D.2.D.4.A.(L).$	x	$B.F_4.3.B.10.V.1.(L).$
$N.B.F_5.43.A.8.V.12.D.(L).$	x	Marquis.
$N.B.F_5.43.A.8.E.7.E.(L.3).$	x	Marquis.
do.	x	B. 256. C.3.(L).
$N.B.F_6.43.A.8.V.4.D.11.(L).$	x	An English Hybrid.
B. 286	x	B. 256. C.3.(L).
B. 286	x	Marquis.
B. 286	x	Equator.
B. 286	x	$B.F_5.U.X.9.E.6.(L).$
B. 286	x	B. 256. G.2.(L).
Equator.	x	An English Hybrid.
Equator.	x	Barwang.
Equator.	x	$B.F_5.U.X.9.E.6.(L).$

The wheat called N.B.F_7.43.C.1.U.3.B.13.A. is a wheat in the seventh filial generation from the cross and has the club-tipped ears to which reference has already been made. Most of the plants, of which this is one, in the culture C.1.U.3.B.13 grown the previous year were resistant to stem rust and the culture C.1.U.3.B.13.A was resistant in 1928.

N.B.F_6.43.K.2.G.6.A.23.(L) was practically immune to stem rust both years as was N.B.F_5.43.A.8.V.12.(L).

N.B.F_4.43.K.2.R.5.(L.2), N.B.F_5.43.A.8.E.7.E.(L.3) and N.B.F_6.43.A.8.V.4.D.11.(L). were practically immune in 1927 and highly resistant in 1928.

N.B.F_5.43.A.8.E.7.E.(L.2) and N.B.F_5.43.D.2.D.4.A.(L) were practically immune in 1927 but in one plot showed resistance and in another susceptibility to stem rust this year, two physiologic forms of stem rust having cropped up.

All these wheats or their near parents had shown great resistance to stem rust in previous years. The appearance of the physiologic form called K.1. is probably responsible for the variation this year from that in 1927 when form K.2. was present. It is possible that form K.1. had not appeared at Njoro previously, but that other forms have been present which have not yet been isolated. The Mycologist has not yet been able to complete his tests on these wheats, but it is expected that they will be completed during 1929.

The idea of using Marquis and Quality wheats is to improve the milling quality of the Njoro wheats.

B.256.C.3.(L), B.F_4.3.B.10.V.1.(L) and Barwang are used to improve the milling quality and also if possible the yield.

Equator is used to improve the resistance of some of the Njoro wheats to yellow rust in those cases where they are not sufficiently resistant at the higher altitudes.

B.256.G.2.(L) is crossed with B.286 because it is resistant to stem rust and appears to have grain of good milling quality as B.286 though it has very weak straw.

It will take some years to produce results from these crosses as only one season a year can be used for propagating the resultant hybrids.

Mau Summit Plant Breeding Station.

Since all the Scott Agricultural Laboratory wheats which were sown at Mau in 1927 were infected with yellow rust, only those which were slightly attacked were sown there again in 1928 for further trial.

Seventeen selected strains from the new Njoro wheats were also tried at Mau Summit in order that they might undergo a more severe test for resistance to yellow rust than they can undergo at Njoro. Practically all the new Njoro wheats seem sufficiently resistant to yellow rust to be grown at Njoro and in similar districts, but some are not sufficiently resistant to be grown at the higher and colder altitudes such as Mau Summit, Molo, Thomson's Falls and Upper Gilgil.

Twenty-four types of wheat selected out of a field of Australian Florence at Keringet in 1927 were also grown at Mau Summit, as were the best of the imported wheats tried last year.

In addition to using the breeding cage, one acre of land outside, kindly prepared by Major Drought, was also utilised.

Fourteen selected strains of new wheats were sown for crossing with Equator; these were not used on account of the severe attacks of stem rust on Equator at the higher altitudes this year, showing that to breed wheats only for resistance to yellow rust for high altitudes would be a mistake in policy.

Mau Summit Plant Breeding Station has therefore to be used for a different purpose than was the original intention. It was begun in order that wheats might be bred there for resistance only to yellow rust because at that time it was thought that stem rust was not a great danger at such altitudes and it is easier to breed wheats resistant to one rust only rather than to two. The experience of the past two years and particularly of last year has shown that stem rust as well as yellow rust can be very destructive at the higher altitudes with the result that Equator, although immune to yellow rust, is no longer a safe wheat to grow in such districts on account of its susceptibility to stem rust.

Wheats will not, therefore, be bred at Mau Summit for resistance to yellow rust; they will be bred, as in the past, at Njoro for resistance both to stem and yellow rust, and strains whose resistance to yellow rust appears doubtful will be grown at Mau Summit for a thorough test.

A list of the wheats grown at Mau Summit and their reactions to rust will be found in Appendix III.

All the Njoro strains which are resistant to stem rust will be grown at Mau Summit in 1929 for a thorough test of their resistance to yellow rust.

Some of the types selected out from Australian Florence, although susceptible to stem rust, were immune to yellow rust and will prove a useful alternative to Equator as a yellow-rust-immune parent for crosses, when immunity to yellow rust is one of the objectives of the cross.

Some of the wheats sent out by Professor Sir Rowland Biffen were unfortunately characterised by having very weak straw.

Co-operative Trials with Farmers.

For some years it has been mooted that there should be a Plant Breeding Station on the Plateau. This, of course, is not possible under the present organisation, but advantage was taken this year of an offer by Sir Neville Pearson to test out new varieties of wheat on his farm, Kipsomba Estate, near Soy. The work was undertaken by Mr. Checksfield under my direction. Mr. Checksfield sowed and harvested the wheats and he and I took notes on them. The list of wheats tried there is given in Appendix I and the rust notes are mostly Mr. Checksfield's.

A smaller number of wheats was tried out on Mr. Barber's farm, Elgon Downs, Ltd., Trans Nzoia. I sowed and took notes on these wheats, and Mr. Whur, the manager, looked after them and harvested them. A list of these wheats with their rust resistance this year is also given in Appendix I.

The results of these experiments, coupled with those at the Plant Breeding Stations, show that we have a large number of new rust-resistant wheats.

In addition to these rod-row plots some larger plots of new varieties were sown at Kipsomba Estate, Elgon Downs, Ltd., and at Kilima Kiu Estates. At Kipsomba the following wheats were sown :—

B.256. C.4.(L).
B. 256. E. 2.
Golden Ball.
Kenya Governor.
B. 286. D.

B. 256. C.4. (L), B. 256. E.2 and Kenya Governor all showed slight signs of stem rust, Golden Ball was more seriously attacked and B. 286. D showed no signs of stem rust at all. B. 256. C. 4. (L) is another strain of the wheat already referred to as having heavy yielding ears but long and rather weak straw.

At Elgon Downs the following wheats were sown :—

Kenya Governor	...	Slight stem rust.
B. 256. E. 1.	...	Slight stem rust.
B. 256 C. 3. (L).	...	Fair stem rust.
B. 286. D.	...	No stem rust except for a very little on one plant.

The attack of rust here was rather more severe than at Kipsomba, and probably got slightly worse after the notes were taken.

At Kilima Kiu the following wheats were sown :—

Kenya Governor	...	Slight stem rust.
B. 256 E. 3.	...	Slight stem rust (but less than Kenya Governor).
B. 256. C.2. (L).	...	Slight stem rust.
B.F_2.36.C.1. (L).	...	Less stem rust than Kenya Governor.
B. 286. D.	...	No stem rust.
B.F_6.4.B.9.C.2.C.69.	...	No stem rust.
B. 256. D.1. (L.1).	...	Slight stem rust.
B. 256. D.1. (L.2).	...	Slight stem rust.

In view of the above results it is interesting to note that a 200-acre field of Kenya Governor was destroyed by stem rust this year on a farm near Magadi Junction, a few miles from Kilima Kiu.

It should be added that Mr. Theunissen, Elgeyo Border, also grew the following wheats :—

Sabanero.
B.F_2.36.C.1.(L).
B. 256. F. (L).

The first two grew well and looked promising, the third was not so good. In the same district Von Lettow wheat and Equator were fairly severely attacked by stem rust, but Burbank and Kenya Governor were free from it.

The following wheats were issued for test in fair bulk to three farmers at high altitudes :—

To Powysland, Molo :—
B.249.B.(L.7).
B.249.B.25.C.
N.B. 230.A.14. (L).
To Canada Farm, Equator :—
B.249.B.13-18.
N.B. 230.A.14. (L).
To Mr. M. H. Abraham, Molo :—
N.B. 23.A. (L.1).
N.B. 230.a.14. (L).

About 15 per cent. of the spikelets in the ears of all these wheats were attacked by yellow rust, but this it not considered at all a severe infection. They all showed slight signs of stem rust.

The wheats numbered B.249 are strains of the same high yielding wheat as B.256. N.B. 230 A.14. (L). is a selection from Bobs crossed Rieti. N.B. 23.A. (L.1) is a selection from the old Cross 13 and has been grown and multiplied by Mr. Patten at Gilgil for several years. It is a very fine wheat but it is too susceptible to stem rust at lower altitudes. It always gets a varying amount of yellow rust at high altitudes and is probably not sufficiently resistant year in and year out for general use. The above wheats are all early maturers.

Present Position as Regards Production of New Wheats.

It is now eight years since I first started my experiments with a view to producing wheats which were both rust-resistant and agronomically useful for the country. It can be definitely stated that the first stage in these experiments appears to have been reached. The useful material with which to make a start was meagre, but we have now a large number of new types of wheats produced by hybridisation which are either highly resistant to stem rust or to both stem and yellow rust in this country and which are also useful agronomically. That these wheats are not in greater bulk is accounted for by lack of continuity in wheat breeding in the past—the " single unit system " being responsible for this—and by a series of bad seasons during which wheats have not been multiplied as rapidly as was hoped.

The expression " the first stage " is used for the reason that farmers must not expect too much of the new wheats. Many whose straw is too weak need not be considered from their point of view. Of the others B. 286 is not a very high yielder and the grain is not as plump as that of the better milling wheats, otherwise it is excellent and should prove a very useful wheat in areas where yellow rust is not a danger, *i.e.*, in areas where Kenya Governor has so far been the best wheat. I have always stated that I regarded Kenya Governor only as a stop-gap, until other wheats have been produced, as I was doubtful of its resistance to stem rust. This doubt has been justified lately by rather serious signs of stem rust at Njoro and the complete destruction of 200 acres of it near Magadi Junction. This was due to attack by the physiologic form of stem rust called K.1. As shown by the Mycologist, Kenya Governor is resistant to form K.2, but moderately susceptible to form K.1. Signs that Kenya Governor was not always quite resistant to stem rust were not wanting in past years in experimental and field plots. Its issue has been justified in that it has proved a very useful wheat in spite of its weak straw, loose chaff and susceptibility to yellow rust; and only one field of it has so far been seriously damaged by stem rust.

This is the first time I have ever been able to state with any degree of confidence that we now have a wheat which in my opinion can be grown without fear of serious loss from stem rust. It has always shown itself practically immune to stem rust in the cage, in experimental plots and in the field in all districts of the Colony. These results are confirmed by the Mycologist, who states that he has found seedling plants of this variety to be physiologically resistant to all forms of stem rust so far found here. If another form is isolated in the future it is to be hoped it will be resistant to that also. If my records can be relied on, in spite of the single unit system, this wheat results from a cross made by me in 1922 between the wheats numbered B.96.A. (L.19) and B. 102. P.96.A. (L.19) was a selection made by me in 1921 from a hybrid of Evans' numbered 12/1—27/10—19 and B. 102 was a selection from Evans' Cross 14/1 (Egyptian crossed Moulds). As to whether these were actually the parents is not certain as by the time I took over the wheat-breeding most of Evans' and Dowson's wheats and their numbers were mixed up. B. 286 actually consists of a mixture of the twenty strains $B.F_2.33.A.3A.$ to T. except for the strain $B.F_2 33.A.3.N.$ This strain has been kept separate under the number B.286.C. as there are indications that it may be a higher yielder than the remainder. Whether it is so or not will be proved during 1929.

In 1927 a few pounds of B.286 were issued to Machakos, the Plateau, the Trans Nzoia and North Kenya. The conditions for issue for multiplication to any particular farmer are that after any harvest the Department of Agriculture is entitled to buy three-quarters of the crop from that farmer at a price of Sh. 25 per bag for resale to other farmers at the same price and under the same arrangement. In addition the remaining quarter of the seed is to be sown for seed purposes. These arrangements are made because after a certain stage has been reached in the multiplication of new varieties the Department of Agriculture is not in a position to continue doing so itself and the services of farmers have to be utilised. In such event the seed has to be issued to such places where the most rapid multiplication will take place and precautions have to be taken—

(1) To prevent the price of seed soaring unduly as was the case with Kenya Governor;

(2) To prevent any grain being sold to the mills before the seed requirements of the country are satisfied.

(3) Eventually to ensure the equal distribution of seed to all farmers in those districts likely to be served by the new wheat.

Some of the obligations agreed to by the grower involve him in unusual expense and trouble and the price of seed has been fixed at Sh. 25 per bag in order adequately to cover this.

It was hoped that there would be sufficient seed of B. 286 available by the end of February, 1930, for every farmer who desired to grow it to obtain all the seed he required for 1930. It is feared that this hope may not be realised owing to some destruction of fields of this wheat early in 1929 by locusts. By judicious issues of seed in 1929 to districts in which wheat can be grown during two seasons in the year and to farmers in other districts who are known to have the best wheat soils there is still the possibility, however, that there may be adequate supplies of seed available for 1930. During the initial stages of the multiplication of a wheat it is not in one way considered important who receives the first issues. The important thing is to get it multiplied as rapidly as possible and the best means to that end is to issue it to those farmers who are in a position to obtain the highest yields. This must be left to the discretion of the Department of Agriculture.

As regards the new Njoro wheats it is proposed to issue a large number of them as separate varieties in 1929, mainly to those districts in which it has been customary to grow Equator in the past. The following system will be adopted. Ten varieties (say) will be issued to a particular Farmers' Association (and ten more to another Association, etc.) for issue, in consultation with the Department of Agriculture, to ten different growers on the same terms as the issue of B. 286. When the Mycologist has completed his experiments with these wheats and when it has been finally decided which of them are identical in every way, farmers will be informed which of them can be regarded as being one and the same wheat so that they can be lumped together and grown on as one wheat.

Other wheats which have been issued, such as the B. 256 and B. 249 types, and the wheats B.F_2.36.C.1. (L) and B. 256.E.1., etc., are not now regarded as of great importance on account of not being quite sufficiently resistant to stem rust, though they may be of some value in particular instances.

Nearly seven acres of B.286.C—a pure-line of B. 286—was sown by the Assistant Agricultural Officer at the Scott Agricultural Laboratories for multiplication purposes during the short rains of 1928. The wheat was drilled at 35 lbs. to the acre and the rows were 16 inches apart. The cultivation and sowing were as usual excellent and I should again, as in previous reports, like to express my appreciation of the excellent way in which such work as this is always done by

B. 2ª WHEAT WITH A SMALL PLOT OF KEKYA GOVERNOR BEHIND TABLE, SHOWING DIFFERENCE IN STRENGTH OF STRAW.

the Assistant Agricultural Officers at the Scott Agricultural Laboratories. I refer in particular to Mr. Lyne Watt and Mr. Gillett, whose interest in the work always ensures the best results being obtained.

Maize Breeding.

The Assistant Plant Breeder was particularly in charge of this under my direction.

Whilst there are several reasons why the average yield of Maize in the Colony is considerably lower than it should be—the most important probably being poor and uneven stands and growing the crop on soils which for lack of proper manuring are incapable of withstanding any degree of drought—the reason the Plant Breeder is most concerned with is the use of seed which has not been well bred, *i.e.*, seed which produces too large a proportion of plants with poor cobs.

Many farmers select cobs from the crib from which to take seed for the following crop but this is not considered to be a sufficiently good method as it is not known what was the appearance or position in the field of the plants which produced these cobs.

A few farmers, and some of these have been assisted by officers of the Department of Agriculture, have adopted the better method of selecting plants in the field and selecting cobs from the selected plants. This method has a drawback however in that a large number of the selected cobs probably do not breed plants and cobs true to the original type and under this system it is impossible to know which cobs are responsible for this. The ear-to-row method of maize breeding is therefore better, as by this method a proper test is made as to which cobs are producing the best progeny and the remainder of the seed only of those cobs is used in the breeding plot. Selection in the field over a period of years does, however, give results in that by selecting only the best plants and cobs and discarding and detasselling poor plants so that they do not fertilize other plants and reproduce themselves, the general level of seed is raised and a smaller percentage of poor plants and cobs whose poorness is due to hereditary causes will be found in the maize fields after a few years.

On the appointment of an Assistant Plant Breeder it was thought possible for the Plant Breeding Section to undertake maize breeding in a proper way and work was therefore begun at Njoro during the past year. As to whether the Njoro Plant Breeding Station is the best place to undertake this work remains to be seen. From the point of view of efficiency it is undoubtely the best as the staff and equipment necessary are all at hand. From the point of view of climatic

conditions it may not be the best place. That part of Njoro is rather cold at nights for maize, so that the highest yields can never be obtained there and cobs are inclined to become flinty in appearance and are, of course, smaller than they would be in the warmer maize belts. It is hoped though, that maize seed which has been improved at Njoro will do very much better when transferred to low altitudes and will, in any case, be much better than the ordinary maize grown in those parts.

It was thought that no useful purpose would be served by importing varieties of maize from other countries for trial here as more than sufficient material to work on can be found in the very mixed type of flat white maize now being grown in the Colony and already so well acclimatized to local conditions. This type of maize has originated from a mixture of Hickory King, Natal White Horsetooth, Salisbury White and Potchefstroom Pearl. Through hybridization it now consists of a large variety of types which do not breed true, but which should respond readily to selection and breeding.

During the breeding work now in progress all the usual points necessary to the improvement of maize seed are receiving close attention, but there is one thing which requires particular attention in this type of maize and that is the depth of grain. Shallow grain appears to be a characteristic of this maize and is doubtless due to the varieies forming its parentage.

With this in mind it was decided to work largely on a type of maize which has been selected for some years by Mr. A. J. Simpson, of Olabanaita. This maize has a particularly deep grain and is a very rought dent. An objection to it is that the grain is thin and rather loose in the row. Another type of maize chosen was that of Mr. Oakes at Njoro. This maize had been selected for several years both by Mr. Oakes and by officers of the Department of Agriculture and already appeared to be an improvement on the type from which it started, although it still inclines to flintiness in appearance. A little work was also done on 8-row Hickory King, mainly to see how the yield of this maize compared with that of the ordinary flat white type.

Two methods of maize breeding were adopted, namely, the " selection in the field " and the " ear-to-row " method.

Selection in the Field.

For the purpose of selection in the field small quantities of Mr. Simpson's seed maize, Captain Kiddle's seed maize, and Mr. Oakes' seed maize were obtained. Captain Kiddle's seed maize was used as it had been originally got from Mr. Simpson and had been acclimatized for one year at Njoro;

it was felt that seed obtained direct from Mr. Simpson might do unduly badly at Njoro, owing to lack of acclimatization, and the use of Captain Kiddle's seed would serve as a test of and safeguard against this.

Two-thirds of an acre was planted with each of these three types of seed and the planting was done by hand on the check row system, four grains to a hill, the hills being a yard apart either way. These hills were subsequently thinned out, the two best plants in each hill being left, and the result was a perfectly even stand of 9,680 plants per acre. An even stand such as this was considered of the utmost importance in experimental work of this kind, for the reason that plants can be selected for vigour with confidence because their increased vigour cannot be due to lack of competition by other plants for the requirements of growth.

During growth, plants were marked for general good appearance, for vigour, early maturity, freedom from diseases, and for having cobs well covered by the sheath and hanging over. The several different points were marked by different coloured tags and at harvest these were transferred to the cob so that, during the final selection of cobs, those with the largest number of particular tags, other things being equal, could be regarded as being the best.

Three types of maize have been selected out from these breeding plots; one is similar to Mr. Simpson's type, and one possibly an improvement on Mr. Oakes'; the third is a flinty type, though not an actual flint maize. The season was a poor one and the number of good cobs few. It was somewhat surprising to observe how few cobs of the type Mr. Simpson is breeding grew from his seed. The best cobs will be sown in three separate breeding plots in 1929.

Ear-to-Row Breeding.

This method of breeding ensures that only those cobs are used for seed which have actually proved themselves as producing the best yielding progeny. It must be understood that the appearance of a cob depends largely on the male and female parentage of the seed from which the plant bearing this cob grew. The seeds on this particular cob have, however, been fertilized by pollen from the male elements (tassels) of a number of plants, some of which may have been good and bearing cobs of the same general type as this particular cob and some of which may have been poor and bearing cobs of a different type from this particular cob. The male parentage of the individual seeds on this cob varied therefore, and some pollen added good characters to some seeds and other pollen added bad characters to other seeds. The consequence of this is that when the seeds from this

particular cob are planted, a percentage of them must give rise to poor plants. It will be readily understood now that if a number of cobs are selected for a breeding plot and they all look equally good, in point of fact some will produce worse progeny than others, because in some cases a larger proportion of seeds will have been fertilized by poor pollen than in other cases. In fact there is no doubt that quite a large proportion of seeds on most selected cobs do not produce good plants and cobs, so that the yields of breeding plots and of farm crops is considerably lowered. The way to avoid this state of affairs is to use, for seed, only those cobs which have proved themselves capable of producing the largest proportion of high-yielding progeny. The ear-to-row method can be used to achieve this result in the following manner.

Say ten cobs are chosen, these are shelled and about half the grain of each is kept back and put in separate bags. The remainder of the grain is planted, the grain from each cob being planted in separate rows of equal length. These rows are harvested and separately weighed so as to show which rows gave the highest yield. Having discovered the two rows say, which gave the highest yield, the seed harvested from these rows is not used again as it has been fertilized by pollen from any sort of maize growing around. The seed which is used for the breeding plot is the other half of the seed which was used to plant those two rows and which was kept back in bags and which should contain about the same percentage of good seeds as did the other half. Further field selection must, of course, be carried out in the breeding plot.

For the purpose of ear-to-row tests at Njoro the following cobs of Mr. Simpson's type were selected :—

29 of his cobs selected from his crib.

29 of his show cobs.

29 cobs selected from Captain Kiddle's crib.

33 of the best cobs from the breeding plot at the Scott Agricultural Laboratories. The seed for this plot came from Mr. Simpson in 1925 and since then cob selection at the Scott Agricultural Laboratories had been done by the Honourable Director of Agriculture and the Assistant Agricultural Officer there. Unfortunately the climatic conditions at the Scott Agricultural Laboratories are unsuitable (*i.e.*, the growing season is too short) for this sort of maize and probably for any dent maize, so that it is impossible to obtain good results except in exceptional seasons. Other types of maize used were as follows :—

44 cobs selected from Mr. Oakes' crib. This crib was filled with cobs from Mr. Oakes' breeding plot, a breeding

plot which had been started in 1925, the selection work during and after that year having been done by Mr. Oakes assisted by officers of the Department of Agriculture.

15 eight-row Hickory King cobs selected from Mr. Braimbridge's show cobs.

A total of 171 cobs on which notes were taken.

Part of the grain (168 seeds to be exact) from each cob was sown in a separate row on the check row system, the remainder of the seed being kept back in bags. There were 42 hills to each row, each hill being a yard apart and each row a yard from the next. Four seeds were sown in each hill and eventually that number of plants was pulled out which would leave the two best plants in each hill. The result of this was that there were exactly 84 plants in each row and it was hoped, therefore, that accurate comparisons of the yielding capacity of each of the 171 cobs would be obtained. When the time came to plant, every fourth row planted was a control, the seed for control rows coming from Mr. Oakes' ordinary seed maize. The control rows, of which there were 66, were planted and treated in the same way as the special rows. With the controls, the total number of rows planted was 237. In order to prevent border effect on the outside rows, two rows were planted up at the ends of each block of rows and to prevent the same thing affecting the end hills of each row, two extra hills were planted at each end of each row. These extra hills and rows were thrown away at harvest.

The results obtained from each row are given in Appendix 4 and should prove interesting to the reader.

Nos. A.3 to A.40 were the cobs selected from Mr. Simpson's crib.

Nos. C.41 to D.107 were the cobs selected from Mr. Oakes' breeding plot crib.

Nos. E.108 to E.130 were the cobs selected from Captain Kiddle's crib.

Nos. F.131 to G.177 were the cobs selected from the Scott Agricultural Laboratories' breeding plot.

Nos. H.178 to H.215 were the cobs selected from Mr. Simpson's show cobs.

Nos. J.217 to J.235 were the cobs selected from Mr. Braimbridge's show cobs of Hickory King.

At harvest the cobs from each row were laid out on gunny bags—one gunny bag to each row—and the progeny from each row was examined by eye. On this method of selection H.189 row was picked out as being the best of Mr. Simpson's type; H.183 was the second best of the same type as H.189, and

it was decided that if H.189 was finally chosen as being the best, that a breeding plot of it should be surrounded by H.183 so as to prevent, as far as possible, H.189 from being fertilized by plants of a different type.

C.44 from Mr. Oakes' rows was selected as being the best row of all and the cob chosen to surround the breeding plot of it was C.41—it being of the same type.

A row, namely E.128, of a flinty type which looked high yielding, was also chosen, and two rows of a flinty type, namely C. 67 and C. 76, were chosen to surround the breeding plot of E.128.

A row chosen as being fairly good was C.59 and the next best ones were A.3, A.7, A.29, A.40, C.64, C.82, C. 84, E.116, E.120, and E.122.

It should be stated that selection by eye in the first instance is of importance in order that different types may be kept apart. This cannot be done after the cobs are shelled.

The next thing done was to count the number of cobs actually harvested from each row and then to shell and weigh every row. A few cobs had been stolen and, as the season had been unfavourable, with very little rain in July and August, a varying number of cobs in each row had not been fertilized at all. This upset all calculations, though it *might* be surmised that rows which gave the largest number of fertilized cobs came from the best seed.

Column 1 gives the number of the row.

Column 2 gives the actual weight in pounds of grain given by the row.

Column 3 gives the average weight in pounds of the grain from the cobs actually harvested.

Column 4 gives the average weight in pounds of grain given by each of the 84 plants.

Column 5 gives the yield per acre, in bags of 200 lb. net, given by each row, based on column 2 and on the area occupied by a row.

The difference in weights between Columns 3 and 4 is accounted for by the presence of unfertilized cobs. Calculations were made by slide-rule.

The statistics of the above experiments were worked out, but it was found that, except in the case of group A, the experimental error of the controls was too large. This was undoubtedly largely due to losses of cobs through non-fertilization, and in part probably to the land being new.

It was considered, however, that the increase in yield over the controls of cobs C.44, H.189 and E.128 shown in Column 5 was probably significant and after going carefully through the yields per acre of the rows no reason was seen for altering the rows already chosen by eye. One row, however, was added, namely, C.45; this row had already been carefully examined but had not been selected as it was of a different type from C.44.

Rows which would be chosen on account of the comparatively high average weight of the cobs actually harvested (where the weights do not differ too much from the weights given in Column 4) are :—A.3., A.7., A.29., A.33., A.40., C.41., C.44., C.45., C.49., C.59., C.61., C.64., C.65., C.67., C.76., C.84., C.82., D.95., E.116., E.124., E.126., E.128., E.130., H.183., H.189., H.193. and H.211.

The list of the numbers here given does not differ much from the list of rows given as already chosen. Those not previously chosen will, however, be added (according to type) to one or other of the breeding plots planted with selections from the selection in the field breeding plots.

Where there is not much difference in yield, desirability of type is important, but actual yield, when there is a real increase, is of the greatest importance and this real increase is found in rows C.44, H.189 and E.128. When the remainder of the seed from these original cobs is planted in breeding plots, the breeding plots will, as mentioned before, be surrounded by what can be called a " surround ", so that plants in the breeding plot will be protected as far as possible from cross-fertilization by plants giving a different type of cob. These surrounds will be planted respectively with seeds from cobs C.41, H.183 and C.67 and C. 76.

Selections will be made only from the breeding plots and not from the surrounds.

This ear-to-row breeding has been discussed at some length and the long list of results given because it is of great importance and is the first time it has been done on a fairly large scale in this country. It is interesting to notice how few cobs at Njoro gave yields appreciably higher than the Njoro control maize (selection work on this maize during previous years has apparently given excellent results) and how many cobs gave yields distinctly poorer; indeed whole groups, such as the Scott Agricultural Laboratories group and in particular the Hickory King group, appeared quite useless here this year, though it may be worth while continuing here or somewhere in the maize belts with the Scott Agricultural Laboratories maize for a year or two to get it acclimatised and see if it brings out any good points it may possess.

The fact of so many cobs in all groups giving yields very much lower than the controls shows (and this is a point to be stressed) how very careful farmers must be to make careful selections of cobs in the field and in breeding plots and not rely on crib selection. To choose seed on the basis of crib selection alone is obviously foolish. These ear-to-row tests also show the vast differences in yielding capacity possessed by seed from different cobs, so much so that it is not necessary to comment further on the importance of ear-to-row tests of cobs in such a mixed type of maize as is found in this country.

Further ear-to-row tests will be made in 1929 and if the season is good it is hoped to obtain more accurate results as to comparative yields of rows so that selection of the best cobs can be more definite.

Something has already been said about the important bearing depth of grain (other things being equal) has on yields. Two cobs which looked extremely similar were chosen as an example and their measurements, etc., are given below, the calculations being made by slide rule :—

	Cob A.	Cob B.
Number of rows	12	12
Number of grains in row.. ..	34	34
Length of cob	15½	16
Weight of cob	238 grammes 8·5 oz.	280 grammes 10 oz.
Weight of core	36 grammes	38 grammes
WEIGHT OF GRAIN	202 grammes 7·23 oz.	242 grammes 8·65 oz.
Percentage weight of grain to weight of cob	85·0%	86·5%
Circumference of cob	16·2 c.m.	17·2 c.m.
Diameter of cob	5·16 ,,	5·50 ,,
Radius of cob	2·58 ,,	2·75 ,,
Circumference of cob	9·9 ,,	9·3 ,,
Diameter of core	3·16 ,,	2·96 ,,
Radius of core	1·58 ,,	1·48 ,,
DEPTH OF GRAIN	1 ,,	1·27 ,,

These two cobs were of the same type and shape and were alike as to number of rows and approximately as to number of grains. There was a very slight difference in length (accounted for more by length of core than by length of rows of grain). It would be expected that the core of Cob B would have weighed less than that of the core of Cob A, this was not the case on account of a difference in density between the two cores, otherwise the difference between the two percentages of weight of grain to weight of cob would have been

INTERIOR VIEW OF PLANT BREEDING LABORATORY, NJORO.

much greater than the difference of 1.5 per cent. actually found. The last seven figures are given to show how the difference in depth of grain between the two cobs was arrived at. Circumferences were measured at the centre of the cob and core. This was considered a sufficiently accurate method for the purpose and shows that there was a large difference in depth of grain between the cobs. In fact the two main differences between the cobs are the depth of grain and the total weight of grain—the latter being obviously largely dependent on the former. The weight of grain on Cob B is 20 per cent. more than on Cob A—a very large difference and one showing that considerable increases in yields should be obtained by using seed giving deep grained cobs. The two cobs were equally dry and had been grown and harvested under similar conditions.

Field Experiments at Njoro Plant Breeding Station.

The Assistant Agricultural Officer was particularly in charge of these under my direction.

As an Assistant Agricultural Officer was to be stationed at Njoro Plant Breeding Station, I considered it possible and advisable to lay down some manurial experiments with wheat and maize. The experiments were designed with a view to giving information to the farmer, in as short a time as possible, as to what methods he should use to improve the yields of crops on soils similar to that at the Plant Breeding Station. The Assistant Agricultural Chemist reported that the soil at Njoro was acid but that the degree of acidity varied considerably and, as was expected, the amount of organic matter varied considerably also; the percentage of " total " phosphoric acid present was always very low. These characteristics are common to many of the indifferent soils found in the Rift Valley. There was the further possibility that the soil might respond to potash.

In addition to the experiments I had already designed I was instructed to lay down a certain rotation experiment (to be described later) with wheat, maize, barley and green manures, some of the crops being fertilised with Seychelles guano and lime.

Chessboard Manurial Experiment with Wheat.

This experiment was designed to be permanent and fairly complete so that the Department might be in a position to give definite advice, from the results of a local experiment, on the economics of wheat manuring and cultivation generally. It was essential to give as many treatments as possible, and yet to keep the number of plots down to a minimum on account of the amount of other work which has to be done and the scarcity of skilled labour, which is plentiful at the Scott

Agricultural Laboratories but unfortunately not so at Njoro. For these reasons it was decided to lay down the experiment in the form known as a chessboard, the treatments to be six, and the plots to be replicated four times.

The plots, which are each 20 yards by 20 yards in area, will eventually be treated as follows :—

(1) Control.
(2) Lime.
(3) Phosphate.
(4) Lime and phosphate.
(5) Lime, phosphate and humus.
(6) Lime, phosphate, humus and potash.
(7) Lime, phosphate, humus, potash and nitrogen.

Lime, phosphate and humus are regarded as the most important treatments, as the soil is more likely to be in need of them, and will become more so after some years of cultivation.

Lime will be applied in the form of finely-ground limestone at a rate of half a ton to the acre.

Phosphate will be applied in the form of superphosphate at a rate probably of 100 lb. to the acre, but the rate will be decided on the results of another experiment. Superphosphate is preferred to the other forms of phosphatic fertilisers on account of its ready solubility and the certainty therefore of obtaining some result the first year, even if a drought is experienced.

Humus will not be applied in the form of a green manure as such a method would involve other factors, which it is not intended to consider in this experiment. It will be applied in the form of green matter to be cut from another place and ploughed in at a suitable time. The green matter to be applied to the plots will be specially grown on plots twice the size of the plots in the experiment. There is another reason for preferring this method to that of green manuring in an experiment designed to prove the value of organic manuring, and that is that results will be more rapidly obtained. Having obtained results, the only other matters to be decided are the sort of green manure to use, and its place and time in the rotation. It is assumed that sufficient quantities of farmyard manure (the best organic manure) are not available for the large acreages under crop in this country.

The plots, of which there are twenty-eight, are laid out in seven rows of four with a four-foot border surrounding each plot, and with a border four feet wide all round the area of some three acres. The plots and borders were drilled with

Kenya Governor wheat in June. No fertilisers were applied this year, as the land was new, and it was doubtful if reliable results could be obtained. The plots will be fertilised in 1929—two years' cultivation being likely to give an even growth of wheat. The 28 plots were, as a matter of fact, separately harvested and the grain from each separately weighed this year, but heavy storms of rain fell during harvest time and injured the grain, much of which was lost whilst being carried under cover, so that no information could be obtained as to how the soil varied over the three acres.

Temporary Strip Fertiliser Experiment on Wheat.

Thirty-one plots, each ten yards by twenty yards, were laid out in one long line and treated as follows :—

(1) Control.
(2) Fertilised with basic slag at a rate of 150 lb. per acre.
(3) Control.
(4) Fertilised with Ephos at a rate of 100 lb. per acre.
(5) Control.
(6) Fertilised with superphosphate at a rate of 130 lb. per acre.
(7) Control.
(8) Fertilised with Seychelles guano at a rate of 90 lb. per acre.
(9) Control.
(10) Fertilised with ground limestone at a rate of 1 ton per acre.
(11) Control.
(12) Fertilised with ground limestone at a rate of 1 ton per acre and superphosphate at a rate of 130 lb. per acre.
(13) Control.
(14) Fertilised with basic slag at a rate of 128 lb. per acre.
(15) Control.
(16) Fertilised with Ephos at a rate of 132 lb. per acre.
(17) Control.
(18) Fertilised with superphosphate at a rate of 149 lb. per acre.
(19) Control.
(20) Fertilised with Seychelles guano at a rate of 149 lb. per acre.
(21) Control.
(22) Fertilised with basic slag at a rate of 150 lb. per acre.
(23) Control.
(24) Fertilised with ephos at a rate of 100 lb. per acre.
(25) Control.

(26) Fertilised with superphosphate at a rate of 130 lb. per acre.
(27) Control.
(28) Fertilised with Seychelles guano at a rate of 90 lb. per acre.
(29) Control.
(30) Fertilised with Seychelles guano at a rate of 120 lb. per acre.
(31) Control.

It was realised that many of the less fertile soils in the Colony gave a response to phosphatic fertilising, but as there are four phosphatic fertilisers readily obtainable in the Colony it seemed of value not only to see if this particular Njoro soil responded to phosphates but also which of the phosphatic fertilisers was best and most economical to use there and elsewhere—a response during the first year being considered an important point.

Calculating on a basis of the percentage of tri-calcium phosphate in the fertiliser and the price per ton of the fertiliser the unit price in Nairobi at that time of—

Basic slag was	Sh. 4/77.
Ephos was	Sh. 2/79.
Ordinary superphosphate was	Sh. 3/62.
Seychelles guano was	Sh. 2/34.

To obtain a certain amount of tri-calcium phosphate, Seychelles guano and ephos are obviously the cheapest phosphatic fertilisers to use. The situation is complicated, however, in that Ephos and Seychelles guano (and also basic slag) require a good rainfall to make them available the first season, whereas superphospate contains a water-soluble phosphate and, though more expensive, should give quicker results; which quicker results could, however, be obtained were much larger proportionate quantities of the insoluble phosphates used.

Plots 2, 4, 6 and 8 were fertilised with the different fertilisers at such rates as would give the same amount of tri-calcium phosphate per acre, reckoning on a basis that 150 lb. of basic slag per acre is sufficient to cause a great improvement in yields of wheat. The comparative costs (at Nairobi) per acre of fertilising at these rates is approximately as follows :—

Basic slag	Sh. **11/35.**
Ephos	Sh. 7/60.
Superphosphate	Sh. 8/70.
Guano	Sh. 6/-.

It was further considered, however, that a farmer might be prepared to spend such a sum as Sh. 10 per acre on phosphatic fertilisers for wheat, and therefore plots 14, 16, 18, and 20 were fertilised at such rates per acre as would cost about Sh. 10 (at Nairobi). These plots would serve the purpose of showing whether any difference in yield resulted from these applications as compared with results obtained from the rates applied to plots 2, 4, 6 and 8.

Plot 8 was fertilised at a rate of 90 lb. of Seychelles guano to the acre and Plot 20 at a rate of 149 lb. Because Seychelles guano is the cheapest phosphatic fertiliser, and because the difference between 90 lb. and 149 lb. is large, Plot 30 was fertilised at a rate of 120 lb. to the acre, costing about Sh. 8 (at Nairobi) per acre.

Plots 22, 24, 26 and 28 were fertilised at the same rates as Plots 2, 4, 6 and 8, but they will not be fertilised next year (the others will), as the intention is to see if any residual values remain.

Plots 10 and 12 were fertilised with lime, and lime and superphosphate, respectively, at the rates stated.

At the present stage of agriculture in the Colony it is not expected that farmers will use fertilisers for wheat unless very obvious results are obtained and so the intention in this experiment was to judge results by eye; that was the reason for making it a strip experiment and so that visitors to the station could see any results for themselves as they walked along the road.

Very great results were obviously obtained from the use of all the phosphatic fertilisers, as the plots fertilised with phosphates could be picked out with the greatest ease by eye on account of the much better and stronger growth on them. The limed plot showed no differences from the control plots. This was probably because the limestone was not sufficiently finely ground to be readily available.

Throughout the following remarks the limed plot is not taken into consideration :—

1. During the early stages of growth the wheat in the fertilised plots was robust and green, whilst that in the controls was sickly and yellow. This advantage was maintained throughout the growing period.

2. Tillering in the fertilised plots was slightly better than in the controls.

3. The fertilised plots came into ear a little earlier than the controls, and the flowering was more even, as were the stands.

4. When heavy rains came at the end of October and the wheat was almost ripe, that on the controls immediately lodged badly (Kenya Governor has weak straw), whilst that on the fertilised plots stood up very well.

5. Even after harvest the phosphated plots could easily be picked out by eye on account of the increased thickness and strength of the stubble over that of the controls.

It has been stated that all the phosphated plots gave good results. Whilst this was so, the plots treated with superphosphate gave obviously better results than the rest, which all seemed about the same, with slag and Ephos perhaps better than the guano.

No obvious differences were observed from the different rates of application of the fertilisers, probably because the soil was very badly in need of phosphates.

In order to determine exactly what increases and what differences in increases in yield were obtained over the controls from the plots fertilised with different phosphatic fertilisers and at different rates, the plots were separately harvested and weighed. No reliable results were obtained for the same reasons as were given in the case of the chessboard experiment.

Temporary Strip Fertiliser Experiment with Maize.

A similar strip experiment as the wheat one, but smaller, was carried out with maize, as follows :—

	Yield per acre in bags.
(1) Control	10.31.
(2) Lime (one ton ground limestone per acre)	11.87.
(3) Control	10.61.
(4) Lime and guano	11.39.
(5) Control	8.34.
(6) Guano (guano at 150 lb. per acre) ...	11.16.
(7) Control	11.47.

Each plot was twelve yards wide and twenty yards deep. The maize was planted on the same check-row system as was adopted for the ear-to-row tests. The first row in each plot was planted 1½ feet inside the plot, so that the last row was also 1½ feet inside at the other side. Rows of maize were therefore not on the edges of each plot. There were exactly the same number of plants per plot. Several rows were planted on each side of the strip to prevent border effect.

Owing to the land being new, the plants in all the plots grew very unevenly, and results from the fertilisers were not obvious to the eye nor, as can be seen, were any reliable results obtained from the actual yields per acre of the plots.

It is not expected that maize will respond as much at Njoro to phosphatic fertilisers as will wheat, because the factor most limiting the growth of maize there is probably the coldness of the climate as compared with that of the warmer maize belts. Nevertheless the strip experiment will be repeated next year, as will the one on wheat.

Comparative Yields of Wheat, Barley and Maize at Njoro.

It was thought that it would be of value to surrounding farmers if some idea could be gained of the comparative economic value of these crops. The soil being light is more suited to maize and barley than to wheat. On the other hand it may be too acid for barley and the climate is rather cold for maize. It might therefore be quite a problem as to which crop to grow.

It was decided to grow an acre of maize, half an acre of wheat, and half an acre of barley. Half of the wheat and half of the barley was fertilised with superphosphate at a rate of 130 lb. to the acre. None of the maize was fertilised, as it was not expected that economic results would be obtained. The maize was planted in the ordinary way with a planter set to plant the rows 42 inches apart and 15 inches apart in the row. The wheat (Kenya Governor) and barley (two-row) were drilled at a rate of 70 lb. to the acre. The maize was planted when the rains came in April, the wheat and barley were sown in June, which has hitherto been the normal time for sowing wheat at Njoro.

The maize gave a yield of 11.68 bags.

The fertilised portion of the wheat yielded at a rate of 4.57 bags per acre.

The unfertilised portion of the wheat yielded at a rate of 4.18 bags per acre.

The fertilised portion of the barley yielded at a rate of 4.49 bags per acre.

The unfertilised portion of the barley yielded at a rate of 3.75 bags per acre.

Under the conditions of this year, maize showed itself as being obviously the best crop to grow. Wheat and barley were about equally bad, but wheat is to be preferred as the price to be obtained per bag is more than can be obtained for a feeding sample of barley. Methods of harvesting barley in this country usually turn a malting sample into a feeding one.

There are several factors to be taken into consideration with regard to the results of this experiment. The wheat and barley received very little rain, as the July and August rains failed. It is proposed to continue the experiment next year, and sow the wheat and barley in April, so as to catch

the best and most certain rains. It is not considered that the August rains will usually be heavy enough to interfere with harvesting operations. A further consideration is that the heavy rains at harvest time in October seriously damaged the wheat and barley, and considerably reduced the yields. This also accounts for the small difference in yield between the fertilised and unfertilised portions of the wheat and barley. The differences to the eye were very much larger. The experiment will be continued for several years, and it is hoped soon to arrive at a definite conclusion from it.

Attention is drawn to the unexpectedly high yield of maize obtained in a very bad year and in a district on the cold side for maize. The cobs were mostly very small, in fact they could be described as nubbins. Although the maize was kept cleaner than is usually the case on farms, an offset to this is that the land was new, the plants growing very unevenly for the first few months. An offset again to this is that because the land was new it contained more organic matter than older land and so was able better to withstand the drought. The spacing of the rows probably had something to do with the high yield, though as far apart as 44 inches is to be preferred. In my opinion the high yield was due to the good and even stand (about 9,000 plants) obtained. 9,000 plants giving only a quarter of a pound of seed apiece would give a yield of just over 11 bags to the acre. Many of the low yields of maize in the country are due to ragged stands and the importance of obtaining a good stand has now been proved in practice.

Rotation Experiment.

I was instructed to lay this down just before the sowing season and the only piece of land then available has turned out to be rather unsuitable, as a portion of it appears to have been old manyatta land, which will upset results for some years to come; so much so that the experiment may not be worth going on with, especially as there are others which will give most of the results looked for.

The experiment was as follows :—

TWO COURSE ROTATION.

1. Maize Maize	6. Maize Wheat	5. Maize (Cowpea inter-planted) Maize
4. Maize Maize	3. Maize Maize	13. Wheat Wheat
12. Wheat Maize	11. Wheat Njahi	10. Wheat Cowpeas
18. Barley Barley	2. Maize Barley	19. Barley Maize
9. Wheat Barley	20. Barley Wheat	17. Cowpeas Wheat
16. Beans (harvested) Wheat	8. Wheat Beans (harvested)	Wheat 22. Wheat
23. Wheat Wheat	24. Wheat Sunflower	25. Sunflower Wheat

THREE COURSE ROTATION.

30. Maize	42. Maize and Fertilizer	48. Green Manure
Maize and Fertilizer	Green Manure	Maize
Green Manure	Maize	Maize and Fertilizer
43. Maize	31. Wheat	44. Green Manure
Wheat	Green Manure	Maize
Green Manure	Maize	Maize and Fertilizer

FOUR COURSE ROTATION.

36. Maize	35. Maize and Fertilizer
Maize and Fertilizer	Wheat
Wheat	Green Manure
Green Manure	Maize
26. Wheat	37. Green Manure
Green Manure	Maize
Maize	Maize and Fertilizer
Maize and Fertilizer	Wheat
34. Maize	27. Wheat
Wheat	Wheat and Fertilizer
Wheat and Fertilizer	Green Crop
Green Manure	Maize
38 Wheat and Fertilizer	33 Green Crop
Green Crop	Maize
Maize	Wheat
Wheat	Wheat

It will be noticed that each rotation is respectively duplicated, triplicated and quadruplicated in reverse or different order, so that seasonal variations will not affect results. Reference to the plan of Njoro Plant Breeding Station will show how I laid out the plots which were 46 in number.

I made the plots for the two and four course rotations ten yards by thirty-one yards in size, and for the three course rotation twenty-one yards by thirty-one yards in size, so that at any time it could be, if desired, turned into a six-course rotation with plots the same size as those in the other two rotations. A border of three feet was left around each plot, but this was sown with maize, wheat or barley, as the case might be, to prevent border effect. The border crops were discarded at harvest. The maize plots were planted by hand on the same check row system already described, and the rows were so spaced as to give exactly the same number of plants in each plot except in the three-course rotation plots, which had exactly double the number of plants; in these plots the centre row was discarded at harvest because, as half of all the plots was limed, there had to be exactly the same number of plants on the limed portions as on the unlimed. The border row at the side of each plot was planted $1\frac{1}{2}$ feet outside the plot, so that the first row of the plot started $1\frac{1}{2}$ feet inside, and the rows were all 3 feet apart. It will be observed that the experiment was laid out with great accuracy so that reliable results could be obtained.

The plots were laid out in three series. The maize was planted with the rains in April, and the wheat (Kenya Governor) and barley (two-row) were drilled in June at a rate of 70 lb. to the acre. Control plots were put in at each end, and the centre of each series. The fertiliser used was Seychelles guano, applied at the rate of 150 lb. to the acre. The

lime was applied in the form of ground limestone (unfortunately, not finely enough ground) at a rate of one ton to the acre.

The plots chiefly affected by manyatta land were Nos. 8, 9, 10, 12, 23, 24, 25, 26, 27 and 28. This seriously damaged the wheat, but improved the sunflowers.

The table showing the yields of grain harvested from the cereal plots is given below. " C " means that the plot was a control, and " F " that it was fertilised with Seychelles guano.

Plot	Crop	Planted	Harvested	Yield per Acre		Average Yield per plot
				Limed Portion	Unlimed Portion	
14C ..	Maize	16–4–28	4–12–28	12·56	12·25	12·40
17C ..	,,	,,	,,	10·14	10·34	10·24
6	,,	,,	,,	8·89	9·60	9·24
5	,,	,,	,,	8·5	7·72	8·11
4	,,	,,	,,	8·55	7·72	8·15
3	,,	,,	,,	6·79	6·08	6·43
2	,,	,,	,,	5·54	6·01	5·77
1C	,,	,,	,,	7·02	6·55	6·78
15C ..	,,	,,	,,	7·57	7·26	7·41
21C ..	,,	,,	,,	11·78	11·00	11·39
28C ..	,,	,,	,,	13·81	13·19	13·50
39C ..	,,	,,	,,	11·55	11·39	11·47
36	,,	,,	,,	10·61	12·56	11·58
35F ..	,,	,,	,,	12·25	11·59	11·92
34	,,	,,	,,	12·10	13·03	12·56
32C ..	,,	,,	,,	11·71	12·41	12·06
30F ..	,,	,,	,,	7·22	11·82	9·52
29C ..	,,	,,	,,	6·67	8·50	7·58
40	,,	,,	,,	10·11	9·44	9·77
41C ..	,,	,,	,,	13·34	12·68	13·01
42F ..	,,	,,	,,	11·71	11·71	11·71
43	,,	,,	,,	12·21	11·16	11·68
46C ..	,,	,,	,,	10·49	10·10	10·29
18	Barley	18–6–28	31–10–28	6·63	5·85	6·24
19	,,	,,	,,	7·61	8·02	7·81
20	,,	,,	,,	6·98	6·63	6·80
13	Wheat	,,	,,	4·87	4·41	4·64
12	,,	,,	,,	3·35	3·78	3·56
11	,,	,,	,,	3·66	2·57	3·12
10	,,	,,	,,	2·65	2·53	2·59
9	,,	,,	,,	3·63	2·84	3·23
8	,,	,,	,,	3·66	3·16	3·41
22	,,	,,	,,	1·91	1·75	1·83
23	,,	,,	,,	1·87	1·44	1·65
24	,,	,,	,,	2·00	2·00	2·00
26	,,	,,	,,	2·03	2·51	2·27
27	,,	,,	,,	5·03	4·25	4·64
38	,,	,,	,,	5·69	4·76	5·22
31	,,	,,	,,	4·73	5·44	5·08

The orderly and great variation in yields shows how much the fertility of the soil varied from place to place. (*Vide* plan.)

The following is the report on the growth, etc., of the green manures and crops other than cereals :—

(*a*) *Plot* 16.—This plot was planted with Canadian Wonder Bean ; the seeds were planted in rows 2 feet 6 inches apart and 4 to 5 inches apart in the row.

Although the germination of the seed was good, subsequent growth was poor, and a yield of only 304 lb. to the acre was harvested. The plot was planted on the 27th April, 1928, and harvested on the 14th August, 1928.

(*b*) *Plot* 17.—Cowpeas were planted in this plot on the 27th April, 1928. The crop suffered somewhat from drought, but on the 12th October when the vines were ploughed under they had spread considerably and the quantity of foliage buried was fair, as was the nodule development on the roots.

The time taken from planting to ploughing in the crop was one hundred and sixty-nine days.

(*c*) *Plots* 33, 37, 44, and 45 were planted with njahi on the 27th April, 1928, and ploughed under on the 12th October, 1928.

The vines in plots 33 and 37 grew very well, and the foliage at the time of ploughing under was good ; the growth, however, of the vines in plots 44 and 45 was not so even.

In plot 44 the vines showed poor growth from the centre of the plot to the borders of plot 45, and in plot 45 from the centre downwards towards plot 43.

The seeds were planted in rows 2 feet 6 inches apart and 4 to 5 inches apart in the row.

These plots received the same treatment as plot 17 before being disced and ploughed under.

(*d*) *Plot* 25.—Sunflower was broadcasted on this plot at the rate of 40 lb. per acre on the 19th May, 1928. After broadcasting the plot was harrowed.

The growth of the crop was excellent.

The crop was rolled and then disced before it was ploughed under ; heads of flowers were just noticeable at the time the latter operations took place.

The luxurious growth attained by this crop may be attributed partially to manyatta land and good rains during growth.

Sixty-eight days elapsed from the time of planting to the time of ploughing in as compared with 168 days in the case of njahi and cowpeas.

The crop rotted very quickly ; this was due to the moist condition of the soil as well as the subsequent rains that fell.

(*c*) *Plot* 5.—This was planted with maize on the 16th April, 1928. On the 10th July, 1928, after the last cultivation had been given, cowpeas were planted between the rows.

The germination and subsequent growth, as well as the nodule development of the crop was poor, due to lack of rain, and it is doubtful whether anything will result from this year's trial.

Work Undertaken Whilst Away from the Plant Breeding Station.

Preliminary Soil Survey.

During past tours of inspection it was felt that in a great many cases farmers were growing wheat and, in some cases, maize on soils extremely unsuitable in their natural conditions for efficient plant growth. The majority of wheat crops seen were always poor (unless very suitable rains fell) and probably hardly paid for the expense of growing them, whereas in parts of a few districts excellent crops were always obtained. As stated above it was obviously (to my mind) a question of soil conditions, and it therefore became increasingly important that a proper knowledge should be acquired of the soils of Kenya, in order to know the best way of improving the poorer ones. This must clearly be a matter of great importance to farmers who have taken up land which they thought to be good, only to find on attempting to grow crops that these were not a success.

The low average yields of wheat obtained throughout the Colony for years past has been undoubtedly due as much, if not more, to growing the crop on soils unsuited to it than to rusts. It was felt that it was a matter for consideration as to whether it was worth while to continue breeding wheats if the country was to continue growing such poor crops, because it was likely that wheat would go out of cultivation in many parts unless farmers could be told authoritatively how to improve their crop yields at small cost. Without this many would soon find themselves in financial difficulties, particularly in those districts suitable climatically only for such crops as wheat. It was therefore realised that a preliminary soil survey of parts of the Colony should be undertaken by a Soil Chemist as soon as possible.

After I had returned from a tour of inspection in West Kenya early in August, matters came to a head and because I already had, from observations made during my former tours, gained an extensive knowledge of where the different soil types and their variations were to be found as well as their agricultural value, and because I would also be able to carry out my usual tours of inspection at the same time and give addresses to farmers' meetings, I was deputed to take the

Assistant Agricultural Chemist (Mr. Gracie, who had also suggested a soil survey) round those parts of the country to which I have referred, so that he could express his opinion on the soils and advise as to how best to improve them—in general before and in particular after he had done the necessary analyses. A great saving in time was effected by adopting this method of conducting the survey.

We started at Nyeri and travelled through to North Kenya asking farmers en route to dig holes (five feet deep and four feet wide) in the ground in selected spots so that the Assistant Agricultural Chemist could examine the soil profile and take samples of soil on the way back. This was done. It was then proposed to continue the survey in the following districts: Nakuru, Njoro, Solai, Rongai, Lower Molo, Ravine, Molo, Mau Summit, Londiani, Timboroa, Burnt Forest, Plateau, Elgeyo Border, Turbo and Trans Nzoia, in 1928; the preliminary survey of the Athi Plains, Kapiti Plains, and of the Machakos and Ulu areas being postponed to early in 1929.

As the time at our disposal was limited, and as it would have involved too much travelling to and fro had we adopted the same method of survey as was used in West Kenya, I previously wrote to a number of farmers in these districts and asked them to dig the holes in particular places on their farms —places which I knew would give the Assistant Agricultural Chemist the necessary information as to the different soils of the districts. The holes were dug as requested, and were examined at periods during the last four months of 1928. The Machakos area was done early in 1929. A large number of soil samples were taken. Extremely valuable information was obtained and given by the Assistant Agricultural Chemist, and lectures on what fertilisers to use, and how to lay down experiments were given by us during these tours. It is not proposed to say any more about this preliminary soil survey in this report, as a preliminary report on the soils, with advice as to improvement, will be issued in bulletin form before the sowing season of 1929, and in greater detail later in the year. It is hoped that wheat and maize farmers will take note of what is said in this preliminary report, so that an increase in average yields of crops may be shown in 1929. A large number of wheat farmers must realise by now that an average yield on their farms as low as four bags of wheat to the acre is not an economic propostion.

White Blight in Maize.

During my tour in the Trans Nzoia I found that a disease which looked like rust, but was actually "white blight" seemed to be doing considerable damage to maize, and, in fact, was considerably reducing the yields. One of the outward signs of this disease is that the leaves of the maize plant appear

to die off prematurely. When this disease attacks maize after the cob has formed, the cob does not fill out as well as it should, but when it attacks maize early in growth either no cob is formed or only a nubbin. In South Africa it is stated that two varieties of maize are resistant to this disease, namely, Hickory King and Natal White Horsetooth. I did not find Hickory King resistant, but Natal White Horsetooth certainly was, though not completely so. Unless "white blight" continues to infect maize as seriously in the future as it did this year, one is not inclined to recommend Natal White Horsetooth as the variety to grow, as it has very shallow grain, and is not one of the highest yielding sorts.

A search through a few maize fields of ordinary hybrid maize gave me the impression that a few plants were far more resistant to this disease than the majority, and these were marked. On my return to Njoro the Assistant Plant Breeder went to the Trans Nzoia and made a systematic search through a number of maize fields for resistant plants, and marked those he found. The cobs from these plants, as well as a few from infected plants, have since been sent down to Njoro for further test at the Plant Breeding Station.

It is not known whether these plants are really resistant or have merely escaped the disease. It is proposed to test this at Njoro, and also in the Trans Nzoia, by means of ear-to-row tests. If they really are resistant, we may probably have to undertake inbreeding in the hope of producing a variety of maize resistant to white blight; that is, if Natal White Horsetooth is not considered a sufficiently high yielder. The experience of other countries is, however, that white blight is not a serious menace, and it is hoped that this will be found to be the case here, and that the appearance and even damage done by white blight will be found to have been caused by the unfavourable weather conditions experienced in the Trans Nzoia this year.

General Remarks on Farm Crops of Wheat and Maize.

There is little of novelty to report on this subject.

Equator suffered very severely from stem rust in high altitude districts, and estimated yields were greatly reduced—in some cases to nothing. It is likely that other crops, such as barley, rye, oats or linseed must be grown in future in these districts until new wheats resistant to both stem and yellow rust are issued in quantity. Addresses were given by me to farmers on this subject in the affected districts. A 200-acre field of Kenya Governor was destroyed by stem rust at Machakos.

In some districts the yields of wheat were poor, due to drought, coupled with infertile or unsuitable soil. The acreage under wheat was higher than it has ever been before.

In many cases very poor yields of maize were obtained in the Nakuru area owing to drought. High yields of maize were expected in the Trans Nzoia. These have not been realised chiefly because of lack of rain during the flowering period in July and August, and also because of "white blight."

Phosphatic fertilisers have secured excellent results where farmers have used them on the more infertile soils. The necessity for improving soils is again stressed, as the price of wheat is likely in future to approximate closely to the export price, and an average yield of six to seven bags to the acre should be regarded as the minimum for successful wheat farming. In this connection, an enormous difference was seen between two wheat crops on adjoining farms in one district. Both crops were sown in July. One crop was growing in a good wheat soil, rich in organic matter, and the other in a good maize soil, but not so rich in organic matter. The first successfully withstood the drought, and gave a fair yield, but the second did not.

Small quantities of two-row barley were grown in the country, but all fields were badly infected with close smut. Some were also infected with stem rust, but the damage done appeared to be small. In some instances the crop seemed promising, but malting samples are not usually secured. This appears to be mainly owing to the method of harvesting adopted, that is, the use of a harvester-thresher. However much the drum and concave and the rate of threshing are adjusted, the awns are still broken off short on the grain. This damages the sample. If barley-growers wish to secure malting samples they are recommended to grow small acreages and harvest with a reaper and binder, afterwards stooking and stacking and then threshing at leisure.

Samples of oats produced in this country are usually very poor and thin. After protracted trials with a large number of imported varieties, Mr. H. M. Abraham of Molo has found one which appears to grow successfully on his farm, and to produce a good sample of grain weighing from forty to forty-five pounds to the bushel. This variety of oats should prove of value.

Crop Trials in Lower Molo.

Owing to the frequent failures of maize crops during partial droughts on old lands in the Rongai and Lower Molo areas, it was decided to lay down an experiment on Mr. Sneyd's farm in Lower Molo, designed to show the remedies necessary to restore the fertility of these worked-out soils. The following report on the experiment this year has been drawn up by Mr. Spranger (the Assistant Agricultural Officer at Njoro, who has had charge of the experiment), and is compiled from his observations and those of Mr. Sneyd :—

Early in March a meeting was held at Mr. Sneyd's farm, Lower Molo, and after considerable discussion it was agreed that the land suffered from :—

(*a*) A deficiency in humus resulting in breaking down of soil structure, surface caking after rain and rapid loss of soil moisture.

(*b*) A pan had formed which prevented plant roots from reaching sufficient depth.

(*c*) Lack of lime.

It was therefore agreed to try the affect of green manuring, sub-soiling and liming.

The land was divided into fifteen one-acre plots, each twenty-one yards wide. One hundred yards of each plot was sub-soiled to a depth of sixteen inches.

Lime at the rate of one ton per acre was applied to a strip one hundred yards in length, fifty yards of which were sub-soiled and fifty yards not sub-soiled; this left in each plot—

(*a*) a portion sub-soiled;

(*b*) a portion sub-soiled and limed;

(*c*) a portion limed;

(*d*) a portion not treated in any way.

The following are the details on each plot, taken from observations made during the year :—

Plot 1.—Planted on 26-4-28; destroyed by caterpillars.

Plot 2.—Planted on 26-4-28; destroyed by caterpillars.

Plot 3.—Planted on 26-4-28; destroyed by caterpillars.

Plot 4.—Kenya Governor planted 4-5-28; destroyed by caterpillars.

Plot 5.—Not planted.

Plot 6.—Barley planted, 12-6-28; droughted.

Plot 7.—Kenya Governor late planted, 12-6-28; droughted.

Plot 8.—Barley planted, 12-6-28; droughted.

Plot 9.—Maize planted, 26-4-28; destroyed by caterpillars.

Plot 10.—Mweli planted 26-4-28; growth fair.

Plot 11.—Buckwheat planted, 26-4-28; growth good, in spite of drought, and 3½ bags of seed was reaped.

Plot 12.—Njahi planted, 24-4-28. The growth of this plot was good, there being a decided difference on the treated portion. The sub-soiled area and the area not treated both showed very poor growth. The limed portion on this plot

NEW VARIETIES OF WHEAT AT SCOTT AGRICULTURAL LABORATORIES SHOWING DIFFERING STRENGTH OF STRAW.

showed up best while the growth in the sub-soiled and limed portion did not show such good growth. The development of nodules, however, was very good, showing up even better than the development on the limed portion.

Plot 13.—Cowpeas planted, 24-4-28. Again the sub-soiled portion and the untreated portion showed up poorly, and there was a marked absence of nodules on the roots. The growth of the limed and sub-soiled and limed portion was good; no difference in growth between these two plots could be observed, but again the sub-soiled and limed portion showed a decided improvement in the development of nodules on the roots over the limed portion.

Plot 14.—*Crotolaria incana* planted 24-4-28. Crotolaria made good growth, and was left untouched by the caterpillar invasion which took place. The crop, however, can hardly be recommended as a green manure owing to its fibrous nature and lack of foliage.

Plot 15.—Buckwheat planted, 26-4-28. Growth fairly good in spite of drought, and 3½ bags reaped.

Remarks.

Njahi and cowpeas both proved successful, but of the two the cowpeas were rather better.

Buckwheat as a crop or green manure can be recommended, but this year, probably owing to drought, the growth was not as good as it might have been, as is indicated by the poor yield of 3½ bags, where 5 to 8 bags should have been reaped.

That a pan has formed on this land is doubtful; although the soil does cake in dry weather the hard pan observed in dry weather disappears completely in wet weather. The real trouble is probably a lack of organic matter.

The maize planted was all destroyed, but on no occasion could any difference be noticed between the sub-soiled plots and the remainder, and it is doubtful whether sub-soiling is a necessity on this type of soil.

I should suggest the following as a general two-years' rotation for this area :—

First Year.—Maize.

Second Year.—Barley (early), sown and harvested, followed by cowpeas, which should be ploughed under green.

Third Year.—Maize.

In the fourth year, buckwheat or rye might be substituted for barley. If buckwheat is planted the volunteer crop after harvest could be ploughed under or the land disced, and a green manure sown and then ploughed in green.

A phosphatic manure is recommended in conjunction with the rotation.

In the experimental plot I should suggest the use of a phosphatic manure plot to be tried against a limed plot, owing to the prohibitive price of lime; it is possible that the results will show up equally well.

Lime appeared to have no effect on crops other than leguminous ones, and if farmers wish to grow leguminous green manures on a large scale it would appear advisable to fertilise them with ground limestone or phosphates—preferably superphosphate.

G. J. L. BURTON,
Plant Breeder.

List of Varieties of Wheats Grown at Njoro During 1928.

APPENDIX I.

NOTE.—The letter "*a*" denotes that the variety of Wheat is practically immune to Stem Rust.
The letter "*b*" denotes that the variety of Wheat is highly resistant to Stem Rust.
The letter "*c*" denotes that the variety of Wheat is moderately susceptible to Stem Rust.
The letter "*d*" denotes that the variety of Wheat is susceptible to Stem Rust.
The same letters apply in the column showing resistance to Yellow Rust.

	1	2	3	4	5	6	7	8	9	10	11
	Yield in bags per acre At Njoro 1928	Bushel Wt. At Njoro 1928	Field Notes on resistance to Stem Rust At Njoro 1927	1928	Field Notes on resistance to Stem Rust 1928			Reactions to Inoculations		Mau Summit	
					Plateau	Trans Nzoia.	Mau Summit.	K.1	K.2	Resistance shown on leaves to Yellow Rust.	Percentage of Yellow Rust in ears.
			K.2	K1.							
Bearded, red chaffed, red grained wheats. N.B.F5.43.											
A.8.D.24 C.(L.1) ..	3,83	58,5	*a*	*a*	..	..	..	*d*	*c*	..	..
A.8.D.27.C.(L.)	..	..	*a*	*a*	*a*	*a*	..	..	..	..	..
A.8 D.27.D.(L.1)	4·86	58	*a*	*b*	..	..	..	*a-d*	*d*	..	..
A.8.D.28.B.(L.1.) ..	4·7	58	*a*	*b*	..	..	..	*a*	*b*	..	..
A.8.D.37.C.(L.1) ..	4·2	59	*a*	*b*	..	..	..	*c*	*c*	..	..
D.2.B.4.A.(L)	2·9	..	*a*	*b*	*a*	..	..	*b*	*b*	..	..
K.4.H.1.E.3.(L)	2·9	..	*b*	*a*	..	..	..	*a*	*b-c*	..	..
K.4.H.1.E.5.(L)	3·5	57	*a*	*a*	..	..	..	*a*	*c*	..	..
K.4.H.1.F.(L.1)	3·5	58·5	*a*	*a*	..	..	..	..	..	..	..
Beardless, red chaffed, red grained Wheats. N.B.F5.43.											
A.8.D.24.C.(L.2) ..	5·1	56·5	*a*	*a*	..	..	..	..	..	..	..
A.8.D.24.C.(L.3) ..	4·7	56	*a*	*a*	..	..	..	..	..	..	..
A.8.D.24.C.8.	3·7	53·0	*a*	*a*	..	..	..	..	..	..	..
A.8.D 24.D.(L.1)	4·4	58·5	*a*	*a*	..	..	..	..	..	..	..
A.8.D.28.B.(L.2) ..	4·2	55·5	*a*	*a*	..	..	..	..	..	..	..
A.8.D.28.B.4.(L) ..	4·1	58	*a*	*b*	..	..	..	..	..	..	..
A.8.D.29.C.(L)	4·0	59	*b*	*a*	..	..	..	..	..	..	..
A.8.D.37.C.(L.2) ..	5·16	58	*a*	*a*	*a*	..	*a*	..	..	*b*	10
A.8.D.37.C.3.(L) ..	4·3	56	*a*	*a*	..	..	..	..	..	..	..
A.8.D.37.C.4.(L) ..	3·7	58	*a*	*a*	..	..	..	..	..	..	..
A.8.N.1.B.(L)	4·1	58·5	*a*	*a*	..	..	..	..	..	..	..
A.8.X.1.C.(L)	4·3	59	*a*	*a*	..	..	..	..	..	..	..
N.B.F6.43.											
D.2.E.2.C.1.(L)	4·9	58	*a*	*a*	..	..	..	..	..	..	..
D.2.E.2.C.2.(L)	4·6	57·5	*a*	*c*	*c*	..	..	*a-d*	..	..	..
D.2.E.2.C.3.(L)	3·87	58·5	*a*	*b*	..	..	..	..	..	..	..
D.2.E.2.C.4.(L)	3·3	56·5	*b*	*b*	..	..	..	..	..	..	..
D.2.E.2.C.6.(L)	1·97	..	*d*	*d*	*d*	..	..	*d*	..	..	..
K.4.H.1.E.19(L)	5·27	58	*a*	*a*	..	..	..	..	..	..	..
K.4.H.1.E.21.(L)	3·76	57	*a*	*a*	..	..	..	..	..	..	..
K.4.H.1.F.(L.2)	4·5	59	*a*	*b*	*a*	..	..	..	..	..	..
Beardless, red chaffed, red grained Wheats (less humped). N.B.F5.43.											
D.2.E.1.D.(L)	2·98	..	*a*	*b*	..	..	..	..	..	..	..
K.2.R.5.(L)	2·93	..	*a*	*a*	..	..	..	..	..	..	..
K.2.R.5.(L.2)	4·6	57·5	*a*	*b*	*b*	*a*	*b*	*a*	..	*b*	Nil
K.4.H.4.(L)	4·75	59·5	*a*	*b*	*b*	..	*b*	*b*	..	*b*	Nil
K.4.I.3.B.(L)	2·35	..	*a*	*a*	..	..	..	..	..	..	..

APPENDIX I.—(*Contd*)

	1	2	3	4	5	6	7	8	9	10	11
	Yield in bags per acre At Njoro 1928	Bushel Wt. At Njoro 1928	Field Notes on resistance to Stem Rust At Njoro 1927	1928	Field Notes on resistance to Stem Rust 1928			Reactions to Inoculations		Mau Summit	
					Plateau	Trans Nzoia.	Mau Summit	K.1	K.2	Resistance shown on leaves to Yellow Rust.	Percentage of Yellow Rust in ears.
			K.2	K1.							
Breadless, red chaffed, red grained Wheats (less humped).—(*Contd.*) N.B.F5.43.											
K.4.I.10.B.(L)	3·75	55·5	*a*	*a*	*b*	..	..	..	..	..	..
K.4.I.12.A.(L.1)	5·4	..	*d*	*b*	*a*	*a*	..	*a*	..	..	..
K.4.I.17.A. & C. ..	5·67	58·5	*a*	*b*	..	..	..	..	..	..	..
K.4.I.23.A.1.(L)	2·02	..	*b*	*d*	..	..	..	..	..	..	..
K.4.I.23.A.7.(L)	5·37	58	*c*	*c*	..	..	..	..	..	..	..
K.4.I.23.A.10.(L) ..	5·8	58	*a*	*c*	..	..	..	..	..	..	..
K.4.I.23.A.11.(L) ..	3·5	57	*b*	*c*	..	..	..	..	..	..	..
K.4.I.23.A.13.(L) ..	5·7	58	*a*	*b*	..	..	..	..	..	..	..
K.4.I.24.C.D. & E. (L.2)	3,64	59·5	*b*	*c*	..	..	..	..	..	..	..
K.4.I.24.C.D. & E.(L.3)..	4·81	59	*b*	*c*	..	..	..	..	..	..	..
K.4.I.26.B.(L)	4·7	57	*d*	*d*	..	..	..	..	..	..	..
K.4.I.26.B.(L.1)	4·1	59	*c*	*a*	*d*	..	..	*a*	..	..	..
K.4.I.26.B.6.(L)	4·3	58·5	*d*	*c*	..	..	..	..	..	..	..
K.4.I.26.B.8.(L)	5·27	60	*b*	*d*	..	..	..	..	..	..	..
K.4.I.26.B.13.(L) ..	2·97	..	*a*	*a*	..	..	..	..	..	..	..
K.4.I.27.C.D. & E.(L) ..	4·67	60·5	*c*	*c*	..	..	..	..	..	..	..
K.4.I.27.C.D. & E.(L.1)..	2·47	..	*d*	*b-c*	*a*	..	..	*a*	..	..	..
K.4.I.28.(L.1)	3·67	56	*d*	*d*	..	..	*b-c*	..	..	*a-b*	Nil
K.4.I.28.(L.2)	3·95	60	*b*	*a*	..	..	..	..	..	..	..
K.4.I.28.(L.3)	7·25	56	*b*	*c*	*c*	..	..	..	..	..	..
Bearded, red chaffed, white grained Wheats. N.B.F5.43.											
A.8.0—11.A.(L.1) ..	4·17	56·5	*b*	*c*	..	..	..	..	..	..	..
A.8.0—11.A.(L.2) ..	5·35	55·5	*a*	*c*	..	..	..	..	..	..	..
A.8.0—11.D.(L)	4·1	55	*c*	*d*	*b*	..	..	*a-d*	..	..	..
D.2.B.7.C.(L)	8·9	57·5	*a*	*b*	*b*	..	..	.. *a*	..	..	..
Beardless, red chaffed, white grained Wheats. N.B.F6.43.											
A.8.E.7.D.5.(L)	..	..	*a*	*d*	..	..	..	..	..	..	..
K.2.G.6.A. 1.(L)	1·3	..	*c*	*d*	..	..	..	..	..	..	..
2.(L)	1·6	..	*c*	*d*	*c*	..	*c*	*d*	..	*b*	10
3.(L)	5·6	59	*a*	*a*	..	..	..	..	..	..	..
4.(L)	4·34	55	*a*	*a*	..	..	..	..	..	..	..
5.(L)	3·81	56·25	*b*	*c*	..	..	..	..	..	..	..
6.(L)	4·45	57·5	*a*	*b-c*	..	..	..	..	..	..	..
7.(L)	5·47	60	*a*	*a*	..	..	..	..	..	..	..
8.(L)	4·45	57·5	*d*	*c*	..	..	..	..	..	..	..
9.(L)	5·85	59	*a*	*a*	..	..	..	..	..	..	..
10.(L)	6·5	58	*a*	*a*	..	..	..	..	..	..	..
11.(L)	6·75	60	*a*	*a*	..	..	..	..	..	..	..
12.(L)	5·36	58	*a*	*c*	..	..	..	..	..	..	..
13.(L)	6·22	59	*a*	*a*	..	..	..	..	..	..	..
14.(L)	5·7	58	*a*	*a*	..	..	..	..	..	..	..
15.(L)	6·25	57·5	*a*	*c*	..	..	..	..	..	..	..
16.(L)	8·55	59	*a*	*a*	..	..	..	..	..	..	..
17.(L)	9·0	59	*a*	*a*	..	..	..	..	..	..	..
18.(L)	7·25	58·5	*a*	*a*	..	..	..	..	..	..	..
19.(L)	5·7	57·5	*a*	*c*	..	..	..	..	..	..	..
20.(L)	7·4	59	*a*	*a*	..	..	..	..	..	..	..
21.(L)	5·8	60	*a*	*a*	..	..	..	..	..	..	..
22.(L)	8·4	59·5	*a*	*a*	..	..	..	..	..	..	..
23.(L)	6·7	57·5	*a*	*a*	*a*	*a*	*a*	*a*	*d*	*b*	35

APPENDIX I.—*(Contd.)*

	1	2	3	4	5	6	7	8	9	10	11
	Yield in bags per acre At Njoro 1928	Bushel Wt. At Njoro 1928	Field Notes on resistance to Stem Rust At Njoro 1927	1928	Field Notes on resistance to Stem Rust 1928			Reactions to Inoculations		Mau Summit	
					Plateau	Transvoia.	Mau Summit.	K.1	K.2	Resistance shown on leaves to Yellow Rust.	Percentage of Yellow Rust in ears.
Bearded, white chaffed, red grained Wheats. N.B.F5.43.			K.2	K1.							
A.8.V.11.A.(L.1) ..	7·05	59	*a*	*a*	..	..	..	..	..	..	..
A.8.V.11.B.(L.1)	7·7	58	*a*	*a*	..	..	..	..	..	..	..
A.8.AM.11.A.(L) ..	4·7	62	*a*	*b-c*	*a*	..	..	..	..	..	..
A.8.AM.14.D.(L) ..	8·2	60	*a*	*b-c*	*a*	..	..	..	..	..	..
A.8.AM.14.E.(L) ..	7·4	59·5	*a*	*a*	..	..	..	..	..	..	..
A.8.AO.3.A.(L.2) ..	6·2	59	*a*	*a*	..	..	..	..	..	..	..
C.12.D.4.C.(L)	4·0	59	*b*	*a*	..	..	..	..	..	..	..
C.12.D.8.C.(L)	5·35	59·5	*a*	*a*	*a*	..	..	*a*	..	..	..
C.12.D.9.C.(L)	3·85	59	*a*	*b*	..	..	..	..	..	..	..
C.12.D.18.C.	4·77	59·5	*a*	*b*	..	..	..	..	..	..	..
N.B.262.(L.1) ..	8·0	61	*d*	*a*	*a*	..	..	*a*	*c*	..	..
N.B.262.G.(L)	7·15	62	*a*	*a*	*a*	..	..	*a*	*c*	..	..
Beardless, white chaffed, red grained Wheats. N.B.F5.43.											
A.8.V.11.A.(L.2) ..	5·6	58·25	*a*	*a*	*a*	..	..	..	..	..	..
A.8.V.11.B.(L.2) ..	6·7	59·5	*a*	*a*	..	..	..	..	..	..	..
B.2.L.3.E.(L)	5·25	59	*a*	*c*	*a*	..	..	*a*	..	..	..
C.5.X.3.B.(L)	6·11	59	*a*	*c*	..	..	..	..	..	..	..
C.5.X.3.E.	7·52	60	*a*	*c*	..	..	..	..	..	..	..
C.12.V.1.C.(L)	7·58	60	*a*	*b*	..	..	..	..	..	..	..
D.2.H.22.D.(L) ..	6·1	59	*a*	*c*	*a*	..	..	..	..	..	..
K.2.R.5.(L.1)	5·7	59·5	*a*	*c*	..	..	..	..	..	..	..
Beardless, white chaffed, red grained slow maturing wheats. N.B.F6.43.											
D.2.H.4.C. 1.(L) ..	4·42	58·5	*b*	*c*	..	..	..	*a*	..	..	..
2.(L) ..	3·16	57	*b*	*d*	..	..	..	*d*	..	..	..
3.(L) ..	5·7	58·5	*b*	*c*	..	..	..	..	..	..	..
4.(L) ..	4·5	56	*b*	*d*	..	..	..	..	..	..	..
5.(L) ..	4·14	58·5	*b*	*d*	..	..	..	..	..	..	..
6.(L) ..	5·2	58·5	*b*	*c*	..	..	..	*a*	..	..	..
7.(L) ..	5·73	58	*b*	*b*	*a*	..	..	*a*	..	..	..
8.(L) ..	4·45	56	*b*	*c*	..	..	..	..	..	..	..
9.(L) ..	4·65	59	*b*	*c*	..	..	..	..	..	..	..
10.(L) ..	2·82	..	*c*	*d*	..	..	..	*a-d*	..	..	..
11.(L) ..	5·6	57·5	*b*	*c*	..	..	..	..	..	..	..
12.(L) ..	5·7	57	*b*	*c*	..	..	..	..	..	..	..
13.(L) ..	2·86	..	*c*	*c*	..	..	..	..	..	..	..
14.(L) ..	5·2	59	*b*	*b*	..	..	..	..	..	..	..
15.(L) ..	3·4	57·5	*b*	*c*	..	..	..	..	..	..	..
16.(L) ..	3·5	59	*c*	*c*	..	..	..	..	..	..	..
17.(L) ..	..	..	*c*	*c*	..	..	..	..	..	..	..
18.(L) ..	1·15	..	*d*	*d*	..	..	..	*d*	..	..	..
19.(L) ..	..	..	*d*	*d*	..	..	..	..	..	..	..
D.2.H.5.A.(L.1)	4·05	57·5	*b*	*c*	*a*	*a*	*b-c*	*b*	..	..	..
D.2.H.5.A.(L.2)	2·82	..	*c*	*d*	*c*	..	*b-c*	..	..	*a-b*	Nil
D.2.H.5.A.(L.3)	1·62	..	*d*	*d*	..	..	..	*d*	..	..	..
D.2.H.24.D.1.(L) ..	4·65	57·5	*a*	*c-a*	..	..	..	..	..	..	..
2(L) ..	4·72	56·5	*a*	*c-a*	..	..	..	..	..	..	..
3(L) ..	4·2	59	*a*	*b*	..	..	..	..	..	..	..
4(L) ..	3·96	58	*a*	*c-a*	*b*	..	..	*a*	..	..	..
5(L) ..	4·73	57	*a*	*c-a*	..	..	..	..	..	..	..
6(L) ..	3·4	57·5	*d*	*c*	..	..	..	..	..	..	..
7(L) ..	1·02	..	*c*	*d*	..	..	..	..	..	..	..
8(L) ..	·44	..	*d*	*d*	..	..	..	..	..	..	..

APPENDIX I.—(*Contd.*)

	1	2	3	4	5	6	7	8	9	10	11
	Yield in bags per acre At Njoro 1928	Bushel Wt. At Njoro 1928	Field Notes on resistance to Stem Rust At Njoro 1927	1928	Field Notes on resistance to Stem Rust 1928			Reactions to Inoculations		Mau Summit	
					Plateau	Trans zoia.	Mau Summit	K.1	K.2	Resistance shown on leaves to Yellow Rust.	Percentage of Yellow Rust in ears.
			K.2	K1.							
* Bearded, white chaffed, white grained wheats. N.B.F5.43.											
A.8.V.4.A.(L)	4·08	58·5	*a*	*a*	..	..	..	..	..	..	..
A.8.V.4.B.(L)	3·84	61	*a*	*a*	*a*	..	..	*a-c*	*c*	..	..
A.8.V.4.C.(L.1)	1·98	..	*d*	*d*	*d*	..	*c*	*d*	..	*b*	5
A.8.V.4.C.6.(L)	4·94	60	*a*	*b*	..	..	..	..	..	..	..
A.8.V.4.D.11.(L)	3,24	58·5	*a*	*b*	..	..	*a*	*b*	..	*b*	Nil
A.8.A.D.4.G.(L)	6·5	60	*a*	*b*	..	..	..	..	..	..	..
A.8.AO.5.B.(L)	4·54	59	*a*	*b*	..	..	..	..	..	..	..
A.8.V.8.B.(L.1)	4·38	60	*a*	*b*	..	..	..	..	..	..	..
Beardless, white chaffed, white grained wheats. N.B.F5.43.											
A.8.E.7.E.(L.1)	1·4	..	*d*	*d*	*c*	..	*c*	*c*	..	*b*	25
E.(L.2)	4·22	57	*b*	*c*	*b*	..	*b-c*	*a-c*	..	*b*	5
E.(L.3)	4·26	56·5	*a*	*b*	..	..	*a*	..	..	*b*	0·15
E.(L.4)	2·06	..	*b*	*c*	..	..	..	..	..	..	..
E.(L)	3·28	58	*a*	*c*	..	..	..	..	..	..	..
A.8.Q.3.B.	3·83	53·5	*b*	*c*	..	..	..	..	..	..	..
A.8.V.1.A.(L.1)	2·92	..	*d*	*d*	..	..	..	*d*	..	..	..
A.(L.2)	2,83	..	*a*	*c*	..	..	..	*d*	..	..	..
A.(L.3)	4·06	58·5	*a*	*b*	..	..	*b*	*a*	..	*a*	1
A.8.V.1.A.1.	3·73	59	*a*	*c*	..	..	..	..	..	..	..
A.8.V.1.A.15.(L)	2·51	..	*c*	*c*	..	..	..	..	..	..	..
A.8.V.2.A.(L)	5·12	58	*a*	*a*	..	..	..	..	..	..	..
A.8.V.4.C.4.(L)	1·78	..	*c*	*d*	*c*	..	*b*	*d*	..	*a-b*	Nil
A.8.V.4.C.7.(L)	3·01	..	*a*	*c*	..	..	..	..	..	..	..
A.8.V.4.D.14.(L)	4·77	59	*b*	*c*	..	..	..	..	..	..	..
A.8.V.8.B.(L.2)	4·67	59	*a*	*a*	..	..	..	..	..	..	..
A.8.V.8.B.(L.3)	3·15	59	*a*	*b*	..	..	..	..	..	..	..
A.8.V.8.B.13.(L.)	5·02	58	*a*	*a*	..	..	..	..	..	..	..
A.8.V.9.C.(L)	5·05	58·5	*a*	*a*	*a*	..	..	..	..	..	..
A.8.V.12.D.(L)	6·15	58	*a*	*a*	..	..	*a*	*b*	..	*b*	15
C.12.B.2.E.9.	4·62	57	..	*a*	*a*	..	..	..	..	..	..
Compact eared wheats.											
N.B.263. A.(L)	2,27	..	*b*	*c*	..	..	..	*a*	*c*	..	..
B.(L)	3·15	5·85	*b*	*c*	*a*	..	..	..	..	..	..
C.(L)	4·5	57·5	*a*	*b*	..	..	..	..	..	..	..
D.(L)	3·12	58	*a*	*c*	..	..	..	..	..	..	..
E.(L)	3·47	57	*b*	*c*	..	..	..	..	..	..	..
G.(L)	2·35	..	*b*	*b*	..	..	..	*a*	..	..	..
H.(L)	4·8	57·5	*b*	*b*	..	..	..	..	..	..	..
I.(L)	3·03	..	*b*	*c*	..	..	..	..	..	..	..
J.(L)	3·1	59	*c*	*c*	*b*	..	..	*a*	*d*	..	..
N.B.F5.											
43.C.12.B.3.F.(L.1)	3,62	61·5	*a*	*a*	..	..	..	..	..	..	..
9.A.6.F.(L.)	4·00	56·5	*a*	*a*	..	..	..	..	..	..	..
43.D.2.D.4.A.(L)	4·62	60	*a*	*c*	*b*	*a*	*b*	*b*	..	*b*	Nil
Oddments.											
Red Egyptian	4·8	59	..	*c*	*a*	..	..	..	..	..	..
N.B.F5.43											
C.5.X.9.B.(L)	3·95	59	..	*c*	..	..	..	..	..	..	..
C.12.X.2.B.(L)	4·28	60·5	*a*	*b*	..	..	..	..	..	..	..

* The wheats in this group were rusted in 1928 by physiologic form K.2, which appeared late in the season, and therefore only affected slow maturing wheats. This also refers to Group N.B.263.A.(L) to N.B.263.I.(L).

APPENDIX I.—(*Contd.*)

LIST OF WHEATS TAKEN FROM SCOTT AGRICULTURAL LABORATORIES AND GROWN AT NJORO IN 1928.

	1	2	3	4	5	6	7	8	9	10	11
	Yield in bags per acre At Njoro 1928	Bushel Wt. At Njoro 1928	Field Notes on resistance to Stem Rust At Njoro 1927	1928	Field Notes on resistance to Stem Rust 1928			Reactions to Inoculations		Mau Summit	
					Plateau	Transvoia.	Mau Summit	K.1	K.2	Resistance shown on leaves to Yellow Rust.	Percentage of Yellow Rust in ears.
			K.2	K.1.							
B.F4.2.D.30.B.2.(L)	..	..	..	..	..	..	..	..	..	..	..
B.256.E.L.	..	..	..	*c*	..	..	..	..	..	..	..
B.256.E.2.	..	..	..	*c*	*a*	*c*	*b*	..	..	*c*	75
B.256.C.3.(L)	..	..	..	*d*	..	..	*b*	..	..	*b*	12
B.256.C.4.(L)	..	..	..	*d*	*b*	*c*	..	..	..	..	..
B.F3.2.C.4.D.(L)	..	..	..	*d*	..	..	..	..	..	..	..
B.F5.U.X.9.E.6.(L)	3·45	59·0	..	*a*	*a*	*c*	*a*	*b*	*b*	*d*	90
B.256.H.(L)	1·72	..	..	*d*	..	..	..	..	..	..	..
B.F3.32.E.5.A.	..	..	..	*d*	..	..	..	*b*	*c*	..	..
B.	..	..	..	*d*	..	..	..	..	..	..	..
C.	..	..	..	*d*	..	..	..	..	..	..	..
E.	..	..	..	*d*	..	..	..	..	..	..	..
F.	..	..	..	*d*	*b*	..	..	..	..	..	..
G.	..	..	..	*d*	..	..	..	..	..	..	..
H.	..	..	..	*d*	..	..	..	..	..	..	..
I.	..	..	..	*d*	..	..	..	..	..	..	..
B.F4.3.B.10.FF.2.(L)	2·85	..	..	*b*	..	..	..	..	..	..	..
4.(L)	·83	..	..	*c*	..	..	..	..	..	..	..
5.(L)	1·46	..	..	*d*	..	..	..	..	..	..	..
6.(L)	·98	..	..	*c*	..	..	..	..	..	..	..
7.(L)	1·47	..	..	*c*	..	..	..	..	..	..	..
8.(L)	1·21	..	..	*c*	..	..	..	..	..	..	..
10.(L)	1·94	..	..	*d*	..	..	..	..	..	..	..
11.(L)	2·32	..	..	*d*	..	..	..	..	..	..	..
13.(L)	3·35	56·5	..	*c*	*a*	..	..	..	..	..	..
14.(L)	..	..	..	*d*	..	..	..	*b*	*b*	..	..
B.F4.3.B.10.DD.1.(L)	..	..	..	*c*	..	..	*b*	*d*	*b*	*b*	50
HH.5.(L)	1·76	..	..	*d*	..	..	..	..	..	..	..
B.F4.3.B.24.A.4.(L)	3·73	58	..	*a*	*a*	..	*b*	..	..	*d*	90
5.(L)	3·78	59·5	..	*a*	..	..	..	..	*d*	..	..
B.F5.4.C.24.F.1.C.(L)	3·97	59	..	*a*	..	..	..	*b*	*b*	..	..
E.(L)	4·85	59·5	..	*a*	..	..	..	*b*	*b*	..	..
F.(L)	4·57	60	..	*a*	..	..	..	*b*	*b*	..	..
H.(L)	2·52	..	..	*a*	..	..	..	*b*	*b*	..	..
O.(L)	4·77	58·5	..	*a*	..	..	..	*b*	*b*	..	..
P.(L)	5·67	59	..	*a*	..	..	*b*	*b*	*b*	*d*	90
V.(L)	4·65	60	..	*a*	..	..	..	*b*	*b*	..	..
D.D.(L)	4·3	58·5	..	*a*	..	..	..	*b*	*b*	..	..
F.2.R.(L)	5·2	60·5	..	*a*	..	..	..	*b*	*b*	..	..
F.3.D.(L)	3·58	58	..	*a*	..	..	..	*b*	*b*	..	..
Chorlim	6·21	57·5	..	*c*	..	..	*b*	*c*	*c*	*d*	90
B.256.D.8.	..	..	..	*c*	*b*	*b-c*	*b*	*d*	*d*	*b*	10
B.F4.249.B.20.E.28.	4·05	60	..	*c*	..	..	..	*d*	*c*	..	..
E.6	..	..	..	*c*	..	..	*b-c*	..	..	*b*	10
E.30.B.	..	..	..	*c*	..	..	*b*	..	..	*b*	10
B.F6.1.C.10.E.4.J.	2·39	..	..	*d*	*d*	*d*	*d*	..	..	*c*	60
B.F4.1.A.42.B.(L)	5·35	55	..	*b*	..	..	..	..	..	..	..
B.F5.4.B.9.E.2.(L.2)	6·9	60·5	..	*b-c*	..	..	..	..	..	..	..
B.F2.36.C.1.(L)	7·6	58	..	*c*	*b*	*b*	*b*	*d*	*a*	*c*	90
Kenya Governor	5·68	60	..	*b-c*	*b*	*b-c*	*b*	*d*	*a*	*b*	90
Bontaar	6·36	59	..	*c*	..	..	..	..	..	..	..
Golden Ball	8·7	60·5	..	*d*	*c*	*b*	*c*	..	..	*c*	30
B.286.	3·7	58	..	*a*	*a*	*a*	*a*	*a-b*	*a*	*d*	50

APPENDIX 2.

LIST OF WHEATS GROWN AT THE SCOTT AGRICULTURAL LABORATORIES DURING 1928.

NOTE.—The letter "*a*" denotes that the variety of wheat showed itself practically immune to Stem Rust.
The letter "*b*" denotes that the variety of wheat showed itself highly resistant to Stem Rust.
The letter "*c*" denotes that the variety of wheat showed itself moderately susceptible to Stem Rust.
The letter "*d*" denotes that the variety of wheat showed itself susceptible to Stem Rust.

	1	2	3	4	5	6
	Yield in acre At Scott Labs. 1928	Bushel Weight At Scott Labs. 1928	Field Notes on resistance to Stem Rust at Scott Labs.		Reactions to Inoculations	
			1927 K.1	1928 K.2	K.1	K.2
B.F4.249.B.20.E. 5	13·2	63	*a*	*b*	*d*	*c*
7	13·4	63	*b*	*b*	*d*	*c*
14	13·4	63	*a*	*b*	*d*	*c*
15	15·1	63	*c*	*b*	*d*	*c*
19	16·3	63	*b*	*b*	*d*	*c*
26	14·0	63	*b*	*b*	*d*	*c*
27	15·1	63	*a*	*b*	*d*	*c*
40	13·8	62	*d*	*b*	*d*	*c*
48	15·1	62	*b*	*b*	*d*	*c*
53	14·6	62	*b*	*a*	..	..
61	10·6	63	*c*	*b*	*d*	*c*
72	14·7	62	*b*	*b*	..	..
B.F5.249.B.3.A.(L)	13·2	62	*d*	*b*	*d*	*d*
B.256.J.(L.2)	15·3	62·5	..	*a*	..	..
B.F4.1.A.33.C.(L)	15·12	60	*a*	*a & d*	..	..
B.F5.2.A.2.E.2.(L).A.	10·21	60	..	*a*	..	..
B.F4.2.C.1.C.1.(L)	12·10	61	*c*	*a*	..	..
B.F3.2.C.4.D.(L)	10·39	..	*c*	*a*	*c*	*b*
B.F4.2.D.30.B.2.(L)	13·81	61	..	*a*	..	..
B.F5.3.A.24.A.1.C.(L)	12·10	59·5	*b*	*a*	..	..
B.F4.3.B.24.A.4.(L)	12·10	59	*a*	*a*	..	..
B.F4.3.B.24.A.5.(L)	8·32	61	*b*	*a*	..	*d*
B.F4.3.B.10.DD.1.(L)	13·23	61	*b*	*b*	..	..
Kenya Governor	14·89	63	*b*	*b*	*c*	*a*
B.286.A.	11·47	60	*a*	*b*	*b*	*a*
B.286.B.	11·72	60	*a*	*a*	..	..
B.286.C.	12·70	60	*a*	*b*	..	..
B.286.D.	10·59	60	*a*	*b*	..	..
B.F2.36.C.1.(L)	15·3	63	*b*	*c*	*d*	*a*
B.256.C.3.(L)	15·5	63	*b*	*c*	*d*	*a*
B.256.C.4.(L)	15·3	63	*b*	*c*	*d*	*a*
B.256.D.6.(L)	15·9	63	*b*	*c*	..	..
9.(L)	14·7	63	*c*	*c*	..	..
10.(L)	13·8	63	*b*	*c*	..	..
15.(L)	15·7	63	*c*	*c*	*d*	*d*
B.256.E.1.(L)	12·18	61	*a*	*b*	*c*	*c*
B.256.E.2.(L)	10·8	61	*a*	*b*	*c*	*c*
B.256.E.3.(L)	13·3	61	*a*	*b*	*c*	*c*
B.256.F.(L)	9·83	60·5	*a*	*c*	..	..
B.256.G.2.(L)	13·5	61	*a*	*a*	*a*	*a*
3.(L)	13·1	61	*a*	*a*	*a*	*a*
4.(L)	13·8	61	*a*	*a*	*a*	*a*
Chorlim Selected	15·69	62	*c*	*c*	*d*	*d*
Akrona	3·28	62	..	*c*	..	..
Acme	8·7	62	..	*b-c*	*d*	*d*
Beliss	6·35	62	..	*b*	..	..
Kubanka	6·5	60	..	*b-c*	*d*	*d*
Arnautka	3·2	61	..	*b-c*	*d*	*d*
Pentad	8·2	62	..	*a-b*	*b*	*c*
Nodak	7·1	60	..	*b*	..	..
Kahla	6·2	62·5	..	*b-c*	..	..
Mindum	4·45	61·5	..	*d*	*d*	*d*
Golden Ball	7·95	61	..	*c*	..	..
Kenya Governor	13·4	63	..	..	..	..

APPENDIX 3.

LIST OF VARIETIES OF WHEAT GROWN AT MAU SUMMIT IN 1928, AND NOT REFERRED TO IN PREVIOUS APPENDICES

	Field Notes on resistance to Stem Rust	Resistance shown on leaves to Yellow Rust	Percentage of Yellow Rust in Ears
B.F6.4.C.24.F.2.C.1	*a*	*d*	90
C.2	*a*	*d*	90
C.3	*a*	*d*	90
7	*a*	*d*	90
B.F4.4.C.15.K.3.(L)	*b*	*d*	40
B.F4.3.B.24.A.4.(L)	*b*	*d*	90
B.F4.2.C.1.C.5.(L)	*c*	*c*	90
B.F6.4.B.9.C.2.G·1 ..	*b*	*c*	70
2	*a*	*c*	70
3	*b*	*c*	70
4	*b*	*c*	70
Russian Wheats.			
No. 35965	*c*	*b*	1
10245	*c*	*c*	100
9517	Did not come to maturity.		
35365	*c*	*b*	Nil
Wheats from Cambridge			
B.273	*a*	*a*	Nil
B.275	*b*	*a*	Nil
B.277	*a*	*b*	Nil
B.278	*a*	*a*	Nil
Other Imported Wheats			
Red Marble	*d*	*b*	Nil
Barwang	*c*	*b*	10
Canberra	*b-c*	*d*	90
Waratah	*b-c*	*c*	70
Aussie	*c*	*c*	5
Bena	*c*	*c*	Nil
Union	*c*	*d*	90
Marquillo	*b-c*	*b*	10
Sabanero	*a*	*b*	0 *to* 20
Kenya Governor	*a*	*b*	90
B.286	*a*	*d*	50
Equator	*c*	*a*	Nil

APPENDIX 4.

LIST GIVING RESULTS OBTAINED FROM MAIZE COBS SUBJECTED TO EAR-TO-ROW TEST.

1	2	3	4	5
Source	Yield of grain from each row in lb.	Average weight of grain from cobs actually harvested from row	Average weight of grain from each plant in the row	Rate of yield in bags per acre from each row
SIMPSON'S COBS	18	·253	·214	10·1
A.3	15·75	·245	·187	8·9
A.4	17·5	·216	·208	9·9
A.5	17	·221	·202	9·6
Control 6 ..	19·75	·26	·235	11·15
A.7	15·5	·22	·184	8·75
A.8	10·5	·19	·125	5·8
A.9	16·5	·217	·196	9·3
Control 10 ..	13	·22	·155	7·35
A.11	13·5	·19	·162	7·6
A.12	13	·213	·155	7·35
A.13	15·25	·218	·182	8·6
Control 14 ..	15·5	·215	·185	8·75
A.15	12·5	·22	·149	7·1
A.16	15	·217	·178	8·5
A.17	16·5	·294	·197	9·5
Control 18 ..	13·25	·23	·157	7·5
A.19	9·	·167	·107	5·1
A.20	12·5	.24	·149	7·1
A.21	15·5	·218	·185	8·75
Control 22 ..	14	·242	·167	7·9
A.23	15·25	·21	·182	8·6
A.24	13	·217	·155	7·35
A.25	15·75	·217	·187	8·9
Control 26 ..	18·25	·237	·217	10·3
A.27	13·75	·222	·164	7·75
A.28	19·75	·286	·235	11·15
A.29	16·5	·226	·196	9·3
Control 30 ..	17·25	·265	·206	9·75
A.31	12·75	·205	·152	7·2
A.32	19·75	·282	·235	11·15
A.33	17·25	·247	·206	9·75
Control 34 ..	12·25	·205	·146	6·9
A.35	13·5	·215	·16	7·6
A.36	9·75	·203	·116	5·5
A.37	16·15	·247	·196	9·3
Control 38 ..	10·5	·223	·118	5·93
A.39	18·5	·288	·22	10·45
A.40				
OAKES' COBS				
C.41	22	·29	·262	12·4
Control 42 ..	18·5	·272	.22	10·45
C.43	9	·214	·107	5·1
C.44	23	·317	·297	14·1
C.45	22·5	·297	·267	12·66
Control 46 ..	17·5	·27	·208	9·9

APPENDIX 4.—(*Contd.*)

1	2	3	4	5
Source	Yield of grain from each row in lb.	Average weight of grain from cobs actually harvested from row	Average weight of grain from each plant in the row	Rate of yield in bags per acre from each row
OAKES' COBS—(*contd*).				
C.47	16·5	·247	·196	9·3
C.48	18	·243	·214	10·1
C.49	18·75	·272	·223	10·6
Control 50 ..	16	·24	·19	9·03
C.51	12	·218	·143	6·76
C.52	16·25	·229	·194	9·2
C.53	13·5	.196	·161	7·6
Control 54 ..	16	·236	·19	9·03
C.55	18	·257	·214	10·1
C.56	16	·239	·19	9·03
C.57	13·25	·204	·158	7·5
Control 58 ..	18	·26	·214	10·2
C.59	20·25	·298	·241	11·45
C.60	16·25	·247	·194	9·2
C.61	20·25	·253	·241	11·4
Control 52 ..	19·5	·27	·232	11·0
C.53	15	·235	·179	8·5
C.64	23	·277	·273	13
C.65	19	·28	·226	10·7
Control 66 ..	20·5	..	·243	11·6
C.67	20	·257	·238	11·28
C.68	14·75	·23	·175	8·3
C.69	6·75	·211	·081	3·3
Control 70 ..	22·25	·3	·265	12·6
C.71	16·25	·227	·194	9·2
C.72	14·25	·246	·17	8·05
C.73	11·75	·25	·14	6·65
Control 74 ..	13·75	·205	·164	7·75
C.75	18·5	·232	·22	10·45
C.76	18·5	·277	·22	10·45
C.77	13·25	·233	·158	7·5
C.82	21·75	·258	·258	12·3
C.83	16·75	·246	·199	9·5
C.84	20	·25	·232	11·28
Control 85 ..	19·5	·25	·232	11
C.86	16·75	·23	·199	9·5
D.87	17	·247	·202	9·6
D.88	16·75	·24	·199	9·5
Control 89 ..	18·5	·234	·22	10·4
D.90	19·25	·246	·229	10·9
D.91	19·25	·238	·229	10·9
D.92	18	·253	·214	10·1
Control 93 ..	19·25	·26	·229	10·9
D.94	17	·243	·202	9·6
D.95	19·75	·283	·235	11·15
D.96	16·5	·254	·191	9·3
Control 97 ..	17·25	·243	·205	9·75
D.98	12·75	·245	152	7·2
D.99	16·25	·233	·194	9·2
D.100 ..	14	·238	·166	7·9

APPENDIX 4.—(*Contd.*)

1	2	3	4	5
Source	Yield of grain from each row in lb.	Average weight of grain from cobs actually harvested from row	Average weight of grain from each plant in the row	Rate of yield in bags per acre from each row
OAKES' COBS—(*contd*).				
Control 101 ..	16·75	·22	·199	9·5
D.102 ..	16	·258	·19	9·03
D.103 ..	16·5	·242	·191	9·3
D.104 ..	15·25	·212	·182	8·6
Control 105 ..	18·25	·24	·217	10·3
D.106 ..	18	·24	·214	10·1
D.107 ..	11·5	·194	·137	6·5
KIDDLE'S COBS				
E.108.. ..	12·25	·24	·146	6·9
Control 109 ..	14·5	·22	·171	8·2
E.110.. ..	14·25	·25	·17	8·05
E.111.. ..	14·25	·28	·17	8·05
E.112.. ..	16	·254	·19	9·03
Control 113 ..	17·5	..	·208	9·9
E.114.. ..	18·25	·265	·217	10·3
E.115.. ..	14·25	·23	·17	8·05
E.116.. ..	20·5	·263	·244	11·6
Control 117 ..	20·25	·267	·241	11·4
E.118.. ..	16·25	·251	·194	9·2
E.119.. ..	16·25	·218	·194	9·2
E.120.. ..	18	·29	·214	10·2
Control 121 ..	18·5	·247	·22	10·45
E.122.. ..	17	·25	·202	9·6
E.123.. ..	17·75	·247	·211	10·0
E.124.. ..	19	·267	·226	10·7
Control 125 ..	18·75	·26	·223	10·6
E.126.. ..	18·75	·257	·223	10·6
E.127.. ..	17·5	·233	·208	9·9
E.128.. ..	24·5	·292	·292	13·85
Control 129 ..	16·75	·223	·199	9·5
E.130.. ..	18	·253	·214	10·1
SELECTED COBS FROM SCOTT AGRIC. LABS.				
F.131.. ..	11·25	·21	·134	6·33
F.132 ..	15	·22	·178	8·5
Control 133 ..	19·25	·238	·229	10·9
F.134 ..	11	·212	·131	6·2
F.135 ..	16·5	·229	·196	9·3
F.136 ..	10·75	·239	·128	6·08
Control 137 ..	16·25	·22	·194	9·2
F.138 ..	10·75	·189	·128	6·08
F.139 ..	11·75	·181	·14	6·65
F.140 ..	16·25	·226	·194	9·2

APPENDIX 4.—(*Contd.*)

1	2	3	4	5
Source.	Yield of grain from each row in lb.	Average weight of grain from cobs actually harvested from row	Average weight of grain from each plant in the row	Rate of yield in bags per acre from each row
SELECTED COBS FROM SCOTT AGRIC. LABS.—(*contd*),				
Control 141 ..	17	·23	·202	9·6
F.142 ..	16·5	·223	·196	9·3
F.143 ..	11·5	·216	·137	6·5
F.144 ..	12·5	·199	·149	7·05
Control 145 ..	20·5	·247	·244	11·6
F.146 ..	12·5	·203	·149	7·05
F.147 ..	14	·246	·167	7·9
F.148 ..	15	·234	·178	8·5
Control 149 ..	17·25	·216	·206	9·75
F.150 ..	16·25	·214	·194	9·2
F.151 ..	17·5	·236	·208	9·9
F.152 ..	6·75	·168	·0805	3·8
Control 153 ..	19	·243	·226	10·7
F.154 ..	20	·278	·238	11·28
F.155 ..	14·5	·213	·171	8·2
G.156 ..	18·5	·236	·22	10·45
G.161 ..	14·25	·245	·17	8·05
G.162 ..	17	·232	·202	9·6
G.163 ..	13·25	·221	·158	7·5
Control 164 ..	17·25	·25	·206	9·75
G.165 ..	9·25	·22	·11	5·2
G.166 ..	11	·19	·131	6·2
G.167 ..	10·25	·186	·121	5·8
Control 168 ..	18·75	·26	·225	10·6
G.169 ..	9·75	·174	·116	5·5
G.170 ..	15·75	·235	·189	8·9
G.171 ..	13·25	·217	·158	7·5
Control 172 ..	17·5	·247	·208	9·9
G.173 ..	18·25	·261	·217	10·3
G.174 ..	12·75	·196	·152	7·2
G.175 ..	13·25	·21	·158	7·5
Control 176 ..	16·15	..	·193	9·3
G.177 ..	14·25	·22	·171	8·2
SIMPSON'S SHOW COBS				
H.178 ..	14·75	·227	·175	8·3
H.179 ..	16·25	·235	·195	9·2
Control 180 ..	16	..	·19	9·05
H.181 ..	17·25	·25	·205	9·75
H.182 ..	Did not germinate.			
H.183 ..	18	·277	·214	10·1
Control 184 ..	19·75	..	·235	11·15
H.185 ..	Did not germinate.			
H.186 ..	Did not germinate.			
H.187 ..	17·75	·291	·211	10·05
Control 188 ..	16·75	·242	·191	9·5
H.189 ..	24·25	·311	·289	13·7
H.190 ..	Did not germinate.			
H.191 ..	Did not germinate.			

APPENDIX 4.—(*Contd.*)

1 Source.	2 Yield of grain from each row in lb.	3 Average weight of grain from cobs actually harvested from row	4 Average weight of grain from each plant in the row	5 Rate of yield in bags per acre from each row
SIMPSON'S SHOW COBS—(*contd*).				
Control 192 ..	17·5	·257	·208	9·9
H.193 ..	21	·276	·25	11·85
H.194 ..	17·25	·257	·205	9·75
H.195 ..	Did not germinate			
Control 196 ..	17·75	..	·211	10·05
H.197 ..	12·25	·231	·146	6·9
H.198 ..	12·25	·215	·146	6·9
H.199 ..	Did not germinate.			
Control 200 ..	19·75	..	·235	11·15
H.201 ..	Did not germinate.			
H.202 ..	18·5	·237	·22	10·45
H.203 ..	12·5	·227	·149	7·05
Control 204 ..	15	..	·178	8·5
H. 205 ..	13·25	·24	·158	7·5
H.206 ..	10·75	·196	·128	6·08
H.207 ..	8·75	·214	·104	4·95
Control 208 ..	10	·164	·119	5·65
H.209 ..	18	·311	·214	10·1
H.210 ..	Did not germinate.			
H.211 ..	21·5	·276	·256	12·2
Control 212 ..	15·25	·225	·182	8·6
H.213 ..	Did not germinate.			
H.214 ..	16·5	·23	·196	9·3
H.215 ..	9·5	·18	·113	5·37
EIGHT-ROW HICKORY KING COBS				
Control 216 ..	15·5	..	·185	8·75
J.217	6	·154	·071	3·38
J.218	8·75	·178	·104	4·95
J.219	6·25	·133	·074	3·53
Control 220 ..	20	·26	·233	11·28
J.221	7·75	·165	·092	4·38
J.222	6·5	·155	·077	3·67
J.223	10·5	·172	·125	3·93
Control 224 ..	18·75	·254	·223	10·6
J.225	11·5	·18	·137	6·5
J.226	6·25	·184	·074	3·53
J.227	7·5	·15	·039	4·25
Control 223 ..	13·25	·253	·217	10·3
J.229	3	·153	·036	1·69
J.230	9·25	·2	·11	5·22
J.231	4	·182	·048	2·26
Control 232 ..	17·5	·257	·203	9·9
J.233	4	·1	·048	2·26
J.234	9·25	·169	·11	5·22
J.235	4·5	·136	·054	2·54

APPENDIX I.

ANNUAL REPORT OF THE SENIOR COFEE OFFICER, 1928.

Staff.

On July 1st, Mr. F. B. L. Butler, Assistant Grader and Inspector was temporarily transferred from Mombasa and was sent to Kiambu and Ruiru to inspect coffee plantations in connection with the outbreak of stephanoderes. He remained on this work for a month and then returned to Mombasa. He inspected 67 plantations.

I had no further assistance until August 21st, when Mr. C. B. C. Handley, Assistant Agricultural Officer, was sent to Limoru District to make a general routine inspection with a view to determining the distribution of mealy bug. On his return to Nairobi from Limuru, Mr. Handley was engaged in the construction of artificial shade over a portion of the coffee variety plots at the Scott Agricultural Laboratories. After the Agricultural Show, Mr. Handley continued Mr. Butler's work in the Ruiru and Thika districts, returning at intervals to Nairobi to deal with routine work at head office during my absence on safari. In the absence of the Acting Entomologist on locust work, he examined and passed some 2,000 lb. of coffee seed. In one case a quantity of Mysore coffee seed was found to be infected with stephanoderes and this consignment was destroyed and the plantation which supplied the seed was placed in quarantine and forbidden to supply any further seed.

Mr. Handley inspected 36 plantations in Limuru, 24 plantations in Kiambu and Ruiru, and 22 plantations in Thika, making a total of 82 inspections.

Travelling.

I was absent from head office on duty for 150 days and I travelled 5,950 miles on Government service.

Interviews.

I held 401 interviews at my office. Mr. Harry Salmon, Managing Director of Messrs. J. Lyons, paid a visit to the Colony and visited a coffee plantation with me.

Correspondence and Prosecutions.

Inward letter numbered 673.

Outward letters numbered 513.

Ten notices under the Diseases of Plants Prevention Rules, 1927, were served on occupiers.

These prosecutions were made :—

1. For failing to notify the Director of Agriculture of the existence of a pest. The defendant pleaded guilty and was fined Sh. 100.

2. For failing to carry out an instruction to destroy some neglected coffee bushes. The defendant pleaded not guilty, but was found guilty and fined Sh. 200.

3. For contravening the Movement of Coffee Plants Regulations by causing to be moved coffee plants from a quarantine area to a clean area. The accused pleaded guilty and was fined Sh. 50.

Publications.

1. Bulletin No. 8 of 1926 " The Coffee Industry of Kenya " was revised.

2. A leaflet on the erection of artificial shade by Mr. Handley.

Re Stephanoderes.

Meetings.

I held eight meetings in the following centres to discuss compulsory stripping of all terminating coffee crops in connection with the outbreak of stephanoderes and control measures recommended by Mr. Wilkinson, the Acting Entomologist. Mr. Wilkinson attended four of the meetings and gave addresses on the subject.

	Attendance.
Punda Milia	9
Donyo Sabuk	10
Nyeri	24
Kiambu Sports Club (Mr. Wilkinson attended)	49
Ruiru Sports Club (Mr. Wilkinson attended)	17
Thika Sports Club (Mr. Wilkinson attended)	42
Punda Milia (second meeting) (Mr. Wilkinson attended)	20
Sotik	17

At each meeting a resolution was passed by the coffee planters pledging themselves whole-heartedly to support the Department of Agriculture in their campaign against stephanoderes.

GREEN MANURING COFFEE WITH "NJAHI."

BUCKWHEAT VARIETY TRIAL, SCOTT AGRICULTURAL LABORATORIES.
LEFT: AMERICAN ACCLIMATISED SEED, AND RIGHT:
POLISH BUCKWHEAT.

Five meetings were arranged in the following districts to discuss coffee matters in general and practical demonstrations on coffee pruning were given.

District.	*Attendance.*	*Topics dealt with.*
Sabukia	18	Types of coffee most suitable for cold situations. Climate, soil, aspect, shade and cultivation in general.
Fort Ternan	10	Control of diseases and pests, with special reference to stephanoderes. Wash, improvement of soil fertility. Pruning.
Mount Elgon	56	Control of diseases and pests. Prevention of wash. Practical demonstration on the pruning of multiple—stem trees and pruning after thrips damage. Types of coffee most suitable for cold situations.
South Cherangani ...	9	Practical demonstration on pruning thrips—damaged trees. Shade. Prevention of wash. Improvement of soil fertility.
North East Cherangani	22	Practical demonstration on pruning thrips—damaged trees. Prevention of wash. Improvement of soil fertility.

Coffee Planters' Union.

The following topics were brought to the notice of the Department by the Committee of the Coffee Planters' Union and dealt with during the year :—

1. The storage of coffee at the Coast.
2. The registration of coffee brands.
3. The reduction of duty and railway rates on cotton wool used in connection with the control of mealy bug.
4. The cleaning of foreign coffee at the Coast.
5. Coffee growing by natives.
6. Regulations governing the sale of fertilisers and pest remedies.

7. The control of stephanoderes.
8. Movement of coffee plants (Donyo Sabuk).
9. The supply of Cresoto.
10. Establishing a Central Coffee Warehouse in Nairobi.

Throughout the year I have kept in close touch with the Committee of the Coffee Planters' Union and have received much valuable assistance and encouragement. In my opinion, it is only by such co-operation that the industry may hope to derive the utmost benefit from all the coffee services.

Coffee Consulting Committee.

Three meetings of the Coffee Consulting Committee were held, on January 4th, May 2nd and November 26th, in the Library of the Department of Agriculture.

Points of particular interest discussed at these meetings included :—

(*a*) *The Cleaning of Foreign Coffee at the Coast.*

A form of licence has been drawn up and approved and will be issued on fulfilment of certain conditions.

(*b*) *The Establishment by Government of Experimental Coffee Plots.*

The following resolution was passed :—

> "That this Committee advocates that Government establishes a coffee experimental station near the centre of the coffee industry under the control of the Department of Agriculture and that the Department of Agriculture sets aside sufficient moneys of the 1929 Estimates for this service."

An experimental station in the centre of the coffee industry would, without doubt, be a very valuable asset to the Colony, provided sufficient money was granted to carry out the work in a satisfactory manner. The trials at the Scott Agricultural Laboratories are on a very small scale, but much valuable information has already and will further be gained from these, and they should be allowed to remain and worked in conjunction with any new experimental station. Until a considerable sum of money is granted for an experimental station situated in the most favourable part of the country, the work at the Scott Agricultural Laboratories should be extended. If an experimental station is started, the trials at the Scott Agricultural Laboratories will always serve a useful purpose, and if such a station is eventually started the work at the Scott Agricultural Laboratories will serve as a valuable basis for future experiments and may be carried on in conjunction with the new station.

About six months after Kabete Government Farm was closed, which was soon after your return from home leave, I brought to your notice that the variety coffee plots and the area which was planted up for shade and manurial work had been abandoned as a result of Kabete being closed down. You told me that it was essential that another experimental station should be started in the near future and instructed me to be on the lookout for about 200 acres of suitable land. I selected an area which I considered suitable for a coffee experimental station, but at the time the policy was one of retrenchment and necessary funds for such a service were out of the question. This land has since been sold and is now an established coffee plantation.

(*c*) *Milling in Transit Rates.*

The new rate which came into force on 1st April, 1928, has caused a certain amount of dissatisfaction. The Manager of the Nairobi Coffee Curing Company has put forward a scheme whereby the present basis of charge, *i.e.*, the percentage loss, is replaced by a tariff based on the parchment weight ex the consigning station to Nairobi for milling, and the clean coffee re-consigned to Kilindini.

This proposition was discussed at the Coffee Consulting Committee meeting on November 26th, and it was agreed to ask that the matter be given further consideration by the Railway Advisory Council and that the present procedure be simplified.

(*d*) *The Control of Stephanoderes.*

At the Coffee Consulting Committee meeting of May 2nd I proposed that the movement of coffee seed should be controlled and that all seed should be inspected and certified free from stephanoderes infection. The principle was agreed to and immediate steps were taken to carry this out. I should like to record my appreciation to Messrs. Simpson and Whitelaw and all coffee planters who voluntarliy co-operated with me in this matter, as the Rule governing the movement of coffee seed did not come into force until 1st January, 1929.

The meeting held on November 26th was convened primarily for the purpose of discussing the proposed measures for the control of stephanoderes. Draft rules governing the movement of coffee, compulsory stripping, and licensing of warehouses were approved, with certain modifications.

These Rules, together with the 1927 Coffee Rules, were gazetted as the Diseases of Plants Prevention (Coffee) Rules, 1928, and came into force on the 1st January, 1929. The

Movement of Coffee Plants Regulations, 1925, and Rules 18 (ii), 19, 20 and 21 of the Diseases of Plants Prevention Rules, 1927, are revoked by His Excellency the Acting Governor in Council.

To give effect to these Rules £5,000 was voted for 1929 and preparations for the campaign against stephanoderes were made with your approval.

(*e*) *The Movement of Coffee Plants Regulations.*

In September a petition was received from the Donyo Sabuk Association stating that *P. lilacinus* (the common mealy bug) had not been indentified in the district and asking that if the district was quarantined for mealy bug could it not be closed to the import of plants from the previously closed mealy bug districts.

A reply was sent giving reasons for the proposed step in which the Acting Entomologist stated that the species of mealy bug found in Donyo Sabuk was indistinguishable from *P. lilacinus* and informing the Association that the declaration of Donyo Sabuk as a quarantine area did not restrict the importation of seedlings from clean areas. In response to further urgent representations on the part of the Association through the Coffee Planters' Union it was decided to declare Donyo Sabuk a quarantine area, but to restrict the importations of coffee plants to clean areas. This was approved by the Coffee Consulting Committee and gazetted in the Diseases of Plants Prevention (Coffee) Rules, 1928, to come into force on the 1st January, 1929.

(*f*) *Regulations Governing the Sale of Fertilisers and Pest Remedies.*

A circular of a Bill drafted by the Agricultural Chemist and which Government would consider was circulated to all members of the Committee for consideration. The object of this was to enable Government to control the quality of materials offered for use as fertilisers, pest remedies and dipping preparations. The importation of these three items during 1927 was valued at £33,000 and the operation of the Ordinance would cost about £1,000 annually.

The Committe decided to hold the Bill in abeyance pending the publication of the next trade statistics, or until there was otherwise a need for its adoption.

Statistical Records.

From statistical information obtained from the Agricultural Census 1928 (July) there are 829 coffee planters in the Colony, representing 42 per cent. of the occupiers in the country.

The total area of coffee planted was 84,073 acres and is made up as follows :—

1—3 years	24,498 acres.
3—6 years	25,691 ,,
6 and over	33,884 ,,

This figure shows an increase of 9,511 acres or 12.8 per cent. over the prevoius year, this being the highest annual increase yet recorded.

The area of coffee which can be regarded as being in the bearing stage in 1927 was 52,851 acres; in 1928 this figure is recorded as being 60,575, showing an increase of 7,724 acres over last year's return yield. Again it must be pointed out that the production has not increased in proportion to the increase of acreage coming into bearing, but this can be accounted for by the fact that the rainfall in 1927, which affects the production in the period under review, was deficient. In the districts or areas where the rainfall was very short, the growth of bearing wood for the March-April flowering was affected. Also in certain parts of the Colony thrips caused considerable damage to the coffee bushes over a large area, and these trees as a result of the thrips damage bore no crop during 1928.

The estimate of production of 1927-28 July-June was 213,043 cwts. The actual crop harvested was 246,292 cwts. including 32,621 cwts. Buni. The estimate of production for 1928-29 is 154,474 cwts.

Exports.

During the year ended 31st July, 1928, 259,689 cwts. of coffee were exported from the Colony, valued at £1,415,537.

This figure represents 49.8 per cent. of the value of the total agricultural exports of the Colony.

Inspections.

The following is a summary of the total number of visits made to coffee plantations during the year showing the diseases and pests recorded :—

I made 267 visits,
Mr. Butler, 67 visits.
Mr. Handley, 82 visits.
Total 416 visits.

FUNGOID DISEASES.

DISTRICT	No. of plantations visited	Leaf Disease	Brown Blight	Coffee Berry Disease	Root Disease	Seedling Disease	Green Scale	Brown Scale	Black Scale	West Indian Red Scale	*Asterolecanium*	*Pulvinaria psidii*	Waxy Scale
Kiambu	71	5	4	..	..	..	11	..	..	..	..	..	3
Scott Labs. ..	12	1	..	..	..	..	1	..	..	..	..	..	..
Limuru	47	11	13	..	..	..	30	6	2	..	..	1	9
Nandi and Songhor	13	11	10	3	..	..	..	..	..	2	..	..	..
Ruiru	63	10	5	..	..	..	9	..	..	..	..	..	..
Nairobi	7	1	..	..	..	..	2	..	..	..	..	..	..
Thika–Fort Hall ..	38	29	19	..	1	..	29	1	..	..	7	..	..
Donyo Sabuk ..	6	6	..	..	..	..	5	..	..	..	2	..	..
Uasin Gishu ..	5	1	1	1	..	..	4	..	..	..	..	..	..
Sabukia	10	..	..	..	..	..	6	..	..	..	..	..	3
Trans Nzoia ..	101	36	9	5	..	..	16	..	..	..	..	..	5
Sotik	9	7	7	6	..	..	..	..	..	..	..	..	..
Nyeri	16	5	..	..	..	..	..	..	..	..	..	..	..
Nakuru–Solai ..	3	..	..	..	..	..	..	..	..	..	..	..	..
Nakuru–Rongai ..	3	..	..	..	..	..	..	..	..	..	..	..	..
Lumbwa	3	1	1	..	..	..	1	..	..	..	..	..	1
Koru	2	2	..	..	..	..	..	..	..	..	..	..	..
Fort Ternan ..	7	7	7	..	..	1	..	1	..	..	..	..	..
Total No. of visits to plantations ..	416												

DISTRICT	No. of plantations visited	Mealy Bug (not identified)	Mealy Bug *Pennisetiosus*	Mealy Bug *Constocki*	Mealy Bug *Lilacinus*	White Borer *Anthores*	Yellow Borer	Black Borer	*Stephanoderes* positive	*Stephanoderes* suspected	Larvæ of Longicorn beetle	Berry Moth or Berry Butterfly	Army Worm	Leaf and Stem Eating Beetles	Leaf-eating caterpillar *Metadrepana Andersoni*	Cutworm	Cutworm Melolonthid beetle	Antestia	Thrips	Aphis	Bagworm
Kiambu	71	1	..	..	13	..	..	..	14	1	7	20	..	4	..	..	..	12	8	..	..
Scott Labs.	12	..	..	..	..	..	..	..	..	..	..	1	..	..	..	1	..	1	..	..	..
Limuru	47	18	..	..	..	..	..	..	..	..	..	10	..	2	..	1	..	31	..	..	..
Nandi and Songhor	13	3	..	..	..	..	..	..	..	..	..	1	..	7	..	..	1	8	8	3	..
Ruiru	63	..	..	..	13	..	..	..	10	5	..	12	3	..	..	..	..	1	9	..	..
Nairobi	7	..	..	..	4	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
Thika–Fort Hall	38	..	..	..	25	3	3	..	1	..	6	32	..	7	..	..	..	7	10	2	..
Donyo Sabuk	6	..	..	1	2	..	1	..	..	..	..	5	..	..	..	..	..	5	6	..	..
Uasin Gishu	5	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	5	..	..
Sabukia	10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	2	..	..
Trans Nzoia	101	..	2	..	..	..	..	2	..	..	..	6	..	1	..	4	..	..	61	..	..
Sotik	9	..	..	..	..	..	..	..	2	1	1	2	..	..	4	1	..	..	..	..	..
Nyeri	16	..	..	..	..	..	..	..	..	..	..	4	..	..	..	3	..	..	2	..	1
Nakuru–Solai	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	..
Nakuru–Rongai	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	3	..	..
Lumbwa	3	..	..	..	..	..	..	..	..	..	..	1	..	..	1	2	..	2	2	..	..
Koru	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	2	2	..
Fort Ternan	7	..	..	..	..	..	..	..	..	..	..	2	..	..	2	..	1	6	1	..	..
Total No. of visits to plantations	416																				

Leaf Disease.

The Nyanza coffee planters, perhaps with a few exceptions, have not realised the big loss of crop which must occur each year owing to the severity of leaf disease and brown blight; this loss could be greatly reduced if systematic spraying was carried out. Yields are also affected as a result of considerable loss of humus due to soil wash. If steps were taken to terrace all the shambas and carry out systematic manuring, the coffee bushes would be able to withstand and not suffer to the extent they do from leaf disease. The land, however, must first be put in a condition to retain the manure before it is applied.

Coffee Berry Disease.

This disease was noticed in a very mild form in the Trans Nzoia. Observations were made on one plantation where the disease attacked well-developed berries at the time the coffee bushes were suffering from lack of moisture. The field was irrigated and as soon as the bushes showed signs of recovering from the effect of lack of moisture it was noticed that the disease was checked. Although strange that the disease should have appeared during a dry spell, the observations made show that if coffee bushes are kept in a strong and healthy condition, coffee berry disease may not make much headway.

In Sotik and Buret, coffee berry disease is reported to have caused considerable loss of crop, more especially on plantations where no spraying had been carried out.

In one instance dissatisfaction was expressed on the result of spraying. On enquiry, however, it was found that the spraying had been carried out when the disease was at its worst!

Green Scale.

At high alttiudes—6,000 feet or over—this scale appears to be more difficult to control than at the lower altitudes.

Mealy Bug : Lilacinus.

Lilacinus must still be regarded as a serious menace to coffee planters in Ruiru and Thika districts. Banding with Cresoto appears to be the most effective method of control.

During the year 4,000 gallons of Cresoto were imported and 3,000 gallons have been ordered and are expected to arrive in the country about the end of January, 1929.

Ps perniciosus was found on two plantations in South-West Trans Nzoia, and in both cases the infection was severe and widely distributed over the plantation.

GLIRICIDIA MACULATA AS SHADE FOR COFFEE
(FROM A CUTTING PLANTED IN 1923).

ARTIFICIAL SHADE FOR COFFEE AT SCOTT
AGRICULTURAL LABORATORIES.

Asterolecanium.

Although this scale is only reported on seven plantations in the Thika-Fort Hall district, it is widely distributed through this area and up to the present it has been found most difficult to control. Infected trees have to be literally scrubbed with an insecticide.

The White Stem Borer, Anthores.

Severe outbreaks occurred in the Ithanga area and hundreds of coffee bushes were uprooted and burnt.

The Yellow and Black Stem Borers.

Reports received during the year from coffee planters show that stem borers are on the increase in the Kiambu-Ruiru-Thika districts.

Stephanoderes.

On the 10th April, 1928, I received a petition signed by twelve coffee planters in Kiambu district informing me that a certain plantation in the district had been severely attacked by a coffee berry borer and requesting me to take action in the matter. On the 16th April, accompanied by Mr. Anderson, the Entomologist, I inspected this plantation and found it in a very neglected condition. A large quantity of the dried coffee on the trees and lying on the ground was collected and taken away by the Entomologist. On the 20th April, he informed me that he had discovered the coffee bean borer stephanoderes in the coffee which we had collected. Up to the end of the year it cannot be stated that this pest has caused any serious loss or done very much damage to coffee, but the potential danger to the industry is great; therefore the new rules in respect of the campaign against this pest must be vigorously enforced.

Antestia.

Very severe outbreaks of this pest occurred in Songhor District. The loss of crop as a result of the damage to the coffee bushes was great. No parasitised eggs were noticed.

On a few plantations where arsenite of soda mixture was applied, antestia was found in small numbers only. In a wet district such as Songhor, it may rain the same day as the mixture is applied, and since the mixture is not sprayed direct on to the trees but only a mist allowed to fall on the foliage, a shower will wash this off immediately. A few years ago, I suggested that a light mist should be sprayed into the centre of the bush provided that this was heavily foliaged; this suggestion has developed into what might at first appear to be a very drastic method. Instead of the mixture being applied through a nozzle, a four-inch distemper brush is used and the trunk is painted in two or three sections. Coffee trees treated

in this manner were examined for scorching, but I could see no detrimental result. It was on these coffee plantations where this treatment had been carried out that antestia appeared to be under control.

Aphis.

This insect appears to be more prevalent in the Nyanza Province than in any other district part of the Colony where coffee is grown.

Coffee Berry Moth.

I am unable to determine whether the damage in every instance is due to the coffee berry moth or the berry butterfly. The Entomologist reports that both do very similar damage. It appears very much on the increase this season, but I have noticed over a period of years that this pest is seasonal.

The Army Worm.

Occurred on a few coffee plantations in Ruiru ; green berries were attacked and on one plantation it is estimated that several tons of coffee were destroyed.

Leaf-eating Caterpillars.

Metadrepana Andersoni occurred in Fort Ternan, Songhor and Sotik. From reports received from Songhor approximately 700 acres of coffee were affected. In Sotik many acres of coffee were defoliated. Arsenate of lead mixture recommended by the Entomologist was found effective.

Thrips.

Occured in most parts of the Colony, but extensive damage was done to coffee in the Trans Nzoia and certain parts of the Uasin Gishu. The damage was so severe on some plantations that durng a part of the year the bushes were completely defoliated. Planters have been advised that in cases where thrips damage causes severe dieback, no pruning whatsoever should be carried out until the affected trees have completely recovered. The new wood should be at least six inches in length before pruning is commenced.

Leaf Miner Moth.

Is not recorded in the summary, as it occurs on every plantation in the Colony. Only one severe outbreak was noticed during the year, in Upper Songhor. The coffee was very heavily shaded and sheltered from the wind.

Berry Fall.

A fall of green berries occurred on several plantations in Songhor and Limuru. Mr. Wilkinson dealt with a similar condition in Uganda, and formed the opinion that the real cause is physiological.

The Mycologist accompanied me to one of the infected plantations in Limuru, and it was decided that certain trials should be undertaken so as to endeavour to find out the cause and remedy, if any.

From observations made, it is considered that this condition is mainly, if not entirely, brought about through the effect of climatic conditions.

On some estates the loss of coffee has been very serious.

Curly Leaf or Black Tip.

An investigation of a so-called disease known in the Nyanza Province as "curly leaf disease" was carried out in May, 1928.

Reports were received that this disease was spreading rapidly through Songhor District. This condition occurs in almost every coffee district in the Colony, but in some districts more so than others. It is considered that it is produced as a result of unfavourable climatic conditions. It is observed that some years it may appear on the increase, but this can be accounted for by the fact that the seasons change in Kenya. The alternation of hot and cold spells is considered to be one of the main factors in causing this condition. In Nairobi, curly leaf has been induced by throwing cold water on the bushes late in the afternoon and early in the morning before the sun is bright.

Showers of rain and brilliant sunshine would have the same effect. The condition can be rectified by erecting a canopy shade immediately over the affected coffee bushes. In areas where it occurs it will be noticed that the worst affected trees are found in the lowest situation, which is subject to considerable variations of temperature. Screens with maximum and minimum thermometers and a rain gauge have been sent to Songhor for observations to be made.

The Scott Agricultural Laboratories.

The Variety Plots.

The following yields are given for comparative purposes :—

Variety	Date sown	Date planted out	Yield in Parchment		
			1927	1928	Total
			lb.	*lb.*	*lb.*
Kent's	24–4–23	April, 1925	301	57	358
Jackson's	27–6–24	do.	202	281	483
Blue Mountain ..	do.	do.	182	245	427
Mysore	do.	do.	193	258	451
Mocha	do.	do.	101	343	444

Kent's is fourteen months older than the other varieties, and so it was to be expected that the 1927 crop should be greater than any of the other varieties, but it was unfortunate that the season was so dry, as the trees suffered from the effect of the drought, and there was no bearing wood in March, 1928.

Mocha, which bore the smallest crop in 1927, was in very good condition with plenty of healthy bearing wood at the end of February, 1928. From observations made up to date, one would suggest Mocha for similar climatic conditions to the Scott Agricultural Laboratories, and Mysore for very cold situations.

The coffee trained on the Agobiada system bore a small crop this season.

Type Selections.

Three plots of specially selected coffee from certain types of bronze-tipped trees were planted out in April. The names to which they will be referred are KS No. 1 and KS No. 2. They are selected seed from trees propagated from seed selected in 1921. The third plot is only a recent selection.

Shade.

Out of all the shade trees which are under trial, *Gliricidia maculata* is the most promising. Some plants of this tree were sent to Koru about five years ago, and they have made very good growth. Plants were sent to other districts for trial, but they have either been neglected and eventually died or were never planted out.

Cuttings and seeds are being distributed from the Scott Agricultural Laboratories. The tree grows very readily from cuttings and as the shade has to be frequently regulated a large number of cuttings are always available. Artificial shade has been erected over three rows of coffee in the variety plots.

Experimental Work.

There was very little time devoted to experimental work during the year. With regard to obtaining satisfactory data on the matter of pruning coffee on different methods, it is necessary to have a small area of coffee in various districts entirely under departmental control. Many so-called co-operative experiments are not satisfactory unless the planter gives a definite undertaking to carry out the work as instructed, and regular visits be paid to observe them. One officer cannot satisfactorily carry out observations on trials all over the Colony and undertake inspection work together with office routine work, which has increased considerably.

General.

A small quantity of coffee seed was collected from one of the bronze-tipped strains for distribution on Elgon, where coffee is being tried at 7,000 feet and over, and at Limuru at 6,750 feet.

All the bronze-tipped strains are more resistant to cold and diseases, but these types are even more so than the named varieties, Jackson's, Kent's, and possibly Mysore. One of these unnamed strains, however, grows a large percentage of malformed beans and produces a small yield, and it is for this reason that coffee planters have been discouraged from establishing any bronze-tipped coffee which is not propagated from Mysore. It is considered that it would be a great help to settlers who are planting coffee at very high altitudes if the Department could undertake to collect and supply selected seed from the best type, but with the existing staff it is out of the question for the Department to undertake this.

Selected coffee seed was sent abroad to :—

The Chief of Bureau of Introduction, Leningrad.

Dr. van de Stok, Belgian Congo.

Secretary for Agriculture, Livingstone.

In connection with the movement of coffee seed and control of stephanoderes, I examined and passed approximately 500 lb. of seed.

A coffee exhibit was prepared for the Rhodesian Agricultural Show and for the Agricultural and Horticultural Show held in Nairobi on the 2nd October. I assisted in judging the coffee exhibits.

A plan of a pulping station to be erected at the Scott Agricultural Laboratories was prepared by the Public Works Department in consultation with me.

The short rains have been quite satisfactory, and there is promise of a good crop next year.

ARTHUR TRENCH,
Senior Coffee Officer.

APPENDIX J.

ANNUAL REPORT OF THE CHIEF GRADER AND INSPECTOR FOR THE YEAR ENDING 31ST DECEMBER, 1928.

Staff.

The following changes occurred during the year :—

Mr. B. F. Ratcliffe, Assistant Grader, resigned his appointment on 31st March.

Mr. A. H. R. House, Temporary Assistant Grader, arrived on 1st April on appointment.

Mr. C. L. Silvester, Assistant Grader, arrived on first appointment on 4th October.

Mr. D. F. Sargent, Foreman Mechanic, returned from vacation leave on 26th October.

Mr. A. H. R. House left the Department on 6th November on the termination of his appointment.

Mr. C. C. T. Sharp, Chief Grader and Inspector, sailed for England on 24th November on sick leave.

Mr. J. Clark, Temporary Assistant Grader, arrived on 11th December on first appointment.

Plant Import Inspection.

The following table shows the quantities and values of the various imports of plants and seeds :—

	No. of packages.	*Declared value.* Sh.	Cts.
Seeds	2,007 ...	64,821	04
Fruit	8,606 ...	119,107	34
Plants	332 ...	7,568	32
Fruit trees ...	125 ...	38,455	41
Tree seed	11 ...	184	50
Tea seed	1,844 ...	280,939	00
Bulbs	158 ...	3,899	55
	Sh.	514,975	16

In addition, 102 packages, value Sh. 1,877/70, were passed in transit to Uganda.

Maize Grading and Conditioning Services.

I attach a table showing the different grades and quantities of maize inspected each month (Table No. 1).

The total of 465,853 bags is a decrease of over 51 per cent. on last year's figures of 970,133.

Shipment of Maize in Bulk.

214,194 bags of K.2 maize were shipped in bulk to European ports.

Wet Maize.

The following table shows the principal quantities of wet maize received, and the districts in which grown, together with the average moisture contents of most :—

Station of origin.	*No. of bags.*	*Average per cent. moisture.*
Kitale	13,218 ...	14.8
Chemelil	5,400 ...	13.7
Nakuru	5,365 ...	15.0
Fort Ternan	4,686 ...	13.5
Turbo	4,458 ...	14.7
Koru	3,877 ...	14.2
Soy	1,837 ...	13.9
Muhoroni	1,513 ...	13.9
Njoro	1,273 ...	14.5
Hoey's Bridge	1,191 ...	14.8
Lugari	1,094 ...	13.9
Rain	632 ...	—
Taveta	550 ...	14.0
Rongai	529 ...	14.5
Olabanita	308 ...	14.5
Eldoret	311 ...	15.0
Karatina	289 ...	15.7
Nyeri	224 ...	13.5
Kisumu	219 ...	15.8
Sabatia	193 ...	14.3
Menengai	132 ...	15.5
Kibigori	112 ...	13.7
Mile 440/10	24 ...	13.5
Mile 30/5	7 ...	13.6
Leseru	77 ...	15.2

Rule 25.

As permitted by this Rule, 107,352 bags of maize were shipped without certificate to ports in Arabia and Eastern Africa.

Rebagged and Resewn.

1,628 sacks of maize were rebagged and 1,027 resewn by the Kenya and Uganda Railway at owners' expense.

WHEAT.

The Wheat Inspection Rules, published in the Gazette, came into force on the 1st July, and 8,461 bags, consisting of 7,595 Grade A and 866 Undergrade were inspected and inspection certificates issued.

In November the Grading of Wheat Rules came into force.

Attached is a table showing the quantities and grades of wheat received (Table 2).

Including the 8,461 bags previously inspected, a total of 66,573 bags have been graded.

Wet Wheat.

The following is a list of stations from which received, and the principal quantities of wet wheat railed from each district :—

Station.	*No. of bags.*	*Average moisture content.* *Per cent.*
Molo	4,863	16.2
Nakuru	3,901	15.8
Solai	3,398	16.4
Ulu	3,419	14.4
Njoro	1,853	14.5
Eldoret	1,657	15.6
Londiani	1,208	16.2
Menengai	1,023	16.0
Rongai	1,003	15.0
Maji Mazuri	850	14.4
Plateau	639	17.0
Mombasa (redirected) ...	279	15.6
Narro Moru	237	15.2
Kijabe	220	15.0
Kipkabus	209	14.8
Laikipia	200	15.2
Taveta	110	15.4
Muhoroni	48	16.0

In December a boat was chartered for a cargo of wheat. Of the 22,512 bags shipped, 17,790 bags required to be reconditioned at the Maize Conditioning Plant. Most of this was railed to the Coast during the two weeks prior to the advertised sailing date. This necessitated the Maize Conditioning Plant working full time.

From the inception of the Wheat Grading Rules on November 1st, it was realised that some form of reconditioning of wheat would be necessary. The existing machinery was accordingly adapted to deal with it. On the whole, the experiment has been successful, the principal troubles encountered being the failure of the Crown Agents to obtain the special milling separator seives ordered, and trouble with the automatic weigher.

Some of the wheat was so wet that a second treatment was necessary to reduce the moisture content to the standard limit of 13 per cent.

42,343 bags wet maize and 4,313 bags weevily maize were reconditioned during the year. In addition, 21,155 bags of wet wheat were treated.

The Maize Conditioning Plant has worked satisfactorily except for boiler tube trouble.

A small size vertical Cochrane boiler was installed as spare, but proved unsatisfactory for the work, and was afterwards removed.

During May, June, July, the annual overhaul was carried out.

Grading of Potatoes.

44,440 cwt. potatoes were graded during the year. A large proportion of the potatoes arriving need to be sorted before being presented for grading; mechanical injury and greenness being the chief defects.

Grading of Beans.

5,074 bags of beans were graded at the request of shippers. Very few beans have been railed to the Coast, presumably owing to a number of districts being gazetted famine areas.

There is a marked falling off in the purity of the produce, and a noticeable increase of bean beetle infection. This may be due to the mixing of old and new crop beans in the Native Reserves.

Cool Stores.

Except for two stops for repairs, the Cool Stores have worked satisfactorily.

The frequent failure of the electric power is a source of annoyance and danger, as the compressor automatically stops under full load, rendering it extremely difficult and dangerous to restart the machinery, owing to the excessive ammonia pressure accumulating above and below the piston. It also entails loss of time in readjusting the setting of the whole plant. The installation of an independent source of power may well be considered.

Improvements have been made in the chambers by fixing channels and receptacles for the catchment of moisture from the tanks and condensation.

I attach a table showing the quantity and kind of produce stored during each month of the year (Table 3).

F. B. L. BUTLER,
Acting Chief Grader and Inspector.

TABLE NO. I.

MAIZE, 1928.

Month	K.2.	K.2.SW.	K.3.	K.3.SW.	K.6.	K.7.	K.8.W.	K.8.N.	K.8.NS.W.	Total Graded	Wet	Musty	Weevily	Other Causes	Total Rejected	Total Received	Rebagged	Resewn
January..	111,690	2,051	3,855	..	..	103	667	73	..	118,439	16,217	263	1,267	42	17,789	136,228	496	330
February	143,982	2,198	4,315	..	44	270	20	2,577	830	154,236	4,284	193	2,946	275	7,693	161,934	457	431
March ..	51,068	5,983	2,544	..	2	213	118	757	1,412	62,097	1,565	1,557	903	439	4,469	66,566	277	144
April ..	18,560	5,248	134	..	1	214	8	115	..	24,230	815	128	283	..	1,226	25,506	157	21
May ..																		
June ..																		
July ..	220	3,817	..	..	..	..	..	..	..	4,037	2	2	112	..	116	4,153	9	9
August ..	1,958	8,515	..	6	..	..	..	..	..	10,479	276	20	839	7	1,142	11,621	134	50
September	1,100	5,756	..	1	..	..	..	..	..	6,857	5	823	83	..	911	7,768	87	17
October..	..	456	..	..	..	..	210	..	..	666	1,985	78	14	865	2,732	3,188	7	12
November	11,268	35	..	..	..	..	..	..	..	11,303	11,041	1	..	..	11,042	22,345	1	7
December	10,160	..	..	..	..	..	..	..	..	10,160	15,386	480	3	305	16,174	26,334	1	..
Totals..	350,006	34,059	10,848	7	47	800	1,023	3,522	2,242	402,554	51,366	3,545	6,455	1,933	63,299	465,643	1,626	1,071

TABLE No II.

WHEAT, 1928

Month	"E" Equator						"G" Kenya Governor					
	1	1. SW.	2	2. SW.	3	3. SW.	1	1. SW.	2	2.SW	3	3. SW.
October	2,173	..	136	..	..	..	..	..	..	..	..	..
November	3,983	..	176	..	7	..	112	..	..	..	..	..
December	2,045	..	247	..	1	..	4,215	..	70	..	3	..
Totals ..	8,741	..	559	..	8	..	4,327	..	70	..	3	..

Month	"D" Durum						"W" Any Other Variety					
	1	1. SW.	2	2. SW.	3	3. SW.	1	1. SW.	2	2. SW.	3	3. SW.
October	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
November	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
December	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,

Month	Total Graded	Rejected.							
		Wet	Musty	Weevily	Other Causes	Total Rejected	Total Received	Rebagged	Resewn
October	2,849	3	..	..	1	4	2,853	8	67
November	4,278	1,496	5	..	1	1,502	5,780	..	..
December	6,581	23,493	931	..	560	24,984	31,565	..	..
Totals ..	13,708	24,992	936	..	562	26,490	40,198	8	67

TABLE No. III.

PRODUCE DEPOSITED IN COOL STORES DURING 1928.

Month	Fruit	Fresh Fish	Cured Fish	Meat Offal	Butter	Beef	Mutton or Pork	Vegetables	Eggs	Cheese	Poultry	Ham & Bacon	Butter	Other Commodities
	lb.	*lb.*	*lb.*	*Pieces*	*Cases*	*Qrs.*	*Carcases*	*lb.*	*Dozen*	*lb.*	*No.*	*lb.*	*lb.*	
January ..	792	476	2,143	91	22	25	7	536	..	150	..	..	..	..
February ..	6,729	504	3,097	37	24	38	14	742	84	..	..	..	..	..
March ..	2,549	1,969	2,899	200	30	16	6	53	25	240	28	..	..	1 box plants.
April ..	15,577	1,273	6,878	60	31	14	34	160	..	48	6	116	..	3 gal. ice cream
May.. ..	31,179	2,389	3,525	78	36	21	28	3,551	..	295	39	..	..	2 cases serum, 2 cases yeast.
June ..	2,540	125	4,040	58	135	16	..	377	..	..	..	..	479	50 lb. yeast.
July ..	19,717	2,060	4,333	..	563	18	11	320	..	..	..	..	..	40 lb. yeast.
August ..	6,123	3,441	4,607	115	92	13	22	1,507	..	..	12	150	..	..
September ..	6,326	679	3,666	30	757	8	2	678	..	..	..	..	..	..
October ..	9,480	710	4,896	25	306	4	7	..	..	..	30	..	..	..
November ..	16,228	330	5,722	100	381	23	7	140	..	196	10	..	..	..
December ..	11,159	240	4,424	..	107	16	5	97	..	20	1	..	..	..
Totals ..	128,399	14,196	50,230	794	2,484	212	143	8,161	109	949	126	266	479	..

APPENDIX K.

REPORT OF ASSISTANT AGRICULTURAL OFFICER, OF FIELD WORK AT THE SCOTT AGRICULTURAL LABORATORIES.

Staff Changes.

Mr. A. G. Bailey, Agricultural Officer, departed from here on 30th January, to take up duty at Bukura, Kavirondo.

Mr. W. O. Sunman reported for duty from England on first appointment on February 21st. He was transferred to another branch on March 26th.

Mr. C. B. C. Handley reported for duty from England on first appointment on March 19th. He proceeded to Meru on April 14th.

Mr. S. Gillett reported for duty from England on first appointment on May 14th. He was drafted to Gilgil on June 23rd for temporary locust duty. He again resumed duty on August 29th.

Rainfall.

The total rainfall was 32.33 inches, or slightly below average for the district. The distribution was very unsatisfactory and long periods of complete drought were experienced. Almost one-quarter of the total rain fell in the early part of one night, and almost one-half fell in the month of May. The result of this was that many of the trials were injured with flooding and scouring while others did not prove on account of drought. Early-maturing crops during the big rains behaved normally.

Travelling.

By motor car, 538 miles. 58 days were spent on duty out of my station.

Correspondence.

Inward letters: 513. Outward letters: 599. There was a substantial increase in correspondence mainly due to enquiries on crops.

Field Trials and Experiments.

(*a*) *Kenya Hybrid Flat White Maize.*

The work on this selection was described in my last two annual reports; the procedure need not be mentioned again. While the yield and return of seed from the droughted crop was a complete failure, the nature of growth was observed to be much more stable than it was in previous years. A careful selection was made for true type cobs and it is hoped that the ultimate results will not be greatly hindered by this bad season.

(b) *White Pearl Maize.*

A small plot was laid down during the big rains and selected cobs from selected stems were kept for distribution.

(c) *" Muratha " Maize.*

This hybrid was planted with the object of perfecting the type. It was originally observed in the South Kikuyu Reserve to be fairly distinct, to be an early-maturing variety and to be giving good crops twice a year. During the last few years it was planted in some of the instructors' shambas and seasonal selections were made there. A poor droughted crop resulted from the trials but some good cobs were secured which were true to type. It is the present intention to continue breeding it.

Maize Variety Trials.

The seed of some of the varieties was old and did not germinate sufficiently well to warrant yields being taken.

The times from sowing till the individual varieties were harvested are given in their order :—

1.	White Cango	150 days.	White maize.
2.	Argentine 40 days ...	150 days.	Yellow maize.
3.	Pride of the North ...	150 days.	Yellow maize.
4.	Muratha	165 days.	White maize.
5.	Silver Mine	170 days.	White maize.
6.	Chester County ...	170 days.	Yellow maize.
7.	Eureka	188 days.	Yellow maize.
8.	Hickory King (8 row)...	199 days.	White maize.
9.	Potchefstroom Pearl ...	199 days.	White maize.
10.	Kenya Hybrid Flat White	209 days.	White maize.

Green Manure Trials.

The fourth series of 61 selections were planted out for comparative trials in May. During the short rains a number were again sown for bulking and further observation. The trials were but a partial success inasmuch as the early maturing crops yielded a normal return of green matter, while the late crops were droughted and could not be used for reliable data. A full report of the findings from many of the green crops for this purpose is now ready for publication.

Fodder Grass Trials.

A series of 30 1/40-acre plots which were originally planted out in 1925 have continued to be of great interest to the pastoralists who have visited the laboratories.

Chart No. 1 gives details of the behaviour and yields of the plots. A few of the grasses have been renamed by the Royal Botanic Gardens, Kew. It was found necessary to eliminate five of the grasses on account of their being either unsuitable for our needs in Kenya or unnecessary to continue with. The varieties are given in the order of the plots and are not systematic.

Green Forage Mixtures.

Fifteen mixtures were selected with either oats, maize or fox tail millet as the cereal in them. Field peas, vetches, beans, lupins and rape were incorporated with these cereals in varying proportions. In forming these combinations the aim was to select seeds of even size so that they could be seeded by one application, the various crops in the mixtures to be equal in speed of growth and also suited to grow in mixture. Records were taken of the green substance harvested from each plot. The experiment is to be continued and certain improvements made from the preliminary work now done.

Lawn Grasses.

A lawn was laid down originally with 9 grasses in November, 1927. All were introduced by means of roots and the conditions were too dry for rapid establishment. The individual periods are given below :—

1. *Pennisetum masaicum.*—This grass was a failure and was replaced with Uganda Lawn Grass.

2. *Uganda Lawn Grass* (not yet identified).—Formed complete sole in 189 days. It forms a very soft mat of a pleasing colour and is easily cut with the mower. Behaviour in dry conditions is yet uncertain, but it not thought to be good.

3. *Paspalum natatum,* Paraguayan Paspalum.—Established in 220 days, or slightly slower than Kikuyu. Is of a dark depressing colour with rather course upright leafage. Easily cut with mower. It has the great advantage of withstanding drought in an exceptional manner and keeps green throughout the year.

4. *Brachiaria Brizanthum.*—Has failed to make a sole of grass and will be replanted by means of seed. It is a very coarse-leaved species and cannot be expected to form an ideal lawn.

5. *Paspalum clandestinum* (Kikuyu Grass) and *Trifolium Johnstoni* (White Kenya Clover) in mixture.—Established completely in 178 days. Forms a very pleasing soft fresh green growth, and being so easily planted it should be one of the best grasses for use in the Highlands of Kenya. It is quite easily cut with the mower. There is a tendency for it to form dead patches in the surface leafage during the dry weather.

6. *No. 81* (not yet identified).—Established in 188 days, forms wiry recumbent growth of a light glaucous colour, and has not the fresh appearance of Kikuyu. Not too good during dry weather.

7. *Cynodon dactylon* (Naivasha Star Grass).—Very easy to establish and is complete in 188 days. It is about the same colour as the former, No. 6, but of a coarser texture. It is not too tough for the mower and makes a hard mat to walk upon.

8. *Pennisetum ciliare.*—Identification was incorrect and two types were planted, thus causing some loss of time. It is not yet established sufficiently to warrant description.

9. *Pennisetum clandestinum* (Kikuyu Grass).—Established in 178 days. It does not keep up the same rich colour during the dry weather as when in mixture with clover.

Some of these grasses are beginning to converge into each other and may supply further interest later on.

Grass Establishment in Cattle Boma.

In November, 1927, a new 2½-acre cattle boma was made and planted as follows :—

(*a*) One-third of area with Kikuyu Grass.

(*b*) One-third of area with Navaisha Star Grass.

(*c*) One-sixth of area with Kikuyu Grass, Naivasha Star Grass and White Kenya Clover.

(*d*) One-sixth of area with Variety Grass Trials.

After planting, the weather set in very dry and the plots did not get the chance that was hoped for.

(*a*) Is the best of all and gives a wealth of luxuriant feed.

(*b*) Is not so good as (a).

(*c*) Is the second best of the three.

(*d*) Out of the twelve grasses planted the best appears to be *panicum coloratum* and some of the next in their order are *panicum meyerianum* (Athi grass), *paspalum dilatum*, *steraria aurea* and *pennisetum ciliare.*

Improvement of Natural Pasture Trials.

There were three series of treatments :—(A) The pasture was dug over and beaten down (with no extra grass introduced). (B) Uncultivated. (C) Heavily harrowed (this was done on the experiment with majembe forks). Chart No. IV will describe the applications on one series.

When the experiment was commenced the following grasses were present and are given in their order of density :—(1) couch grass, (2) oat grass, (3) Naivasha star grass, (4) *Brachiaria brizantha*, (5) a Carex (not identified) and (6) *Sporobolus indicus*. No clover was present.

The cattle are allowed to select their grazing over the area and this is done fairly often to keep the growth low.

Establishment of Pasture on Cultivated Land.

Six plots were planted with barley, wheat, rye, buckwheat, fox-tail millet and finger millet (wimbi). Each plot was under four treatments, viz : (1) Control (or no grass introduced), (2) Kikuyu grass, (3) Kikuyu grass and white Kenya clover mixed, and (4) a mixture of English grasses and clovers.

After these cereals were above ground a few inches the grasses were planted and developed under cover of the nurse crops. The results of this experiment are detailed in a leaflet which is being published.

Clover Trials.—1928.

Nine local selections and varieties were planted in May. They suffered during the very dry summer and failed to cover the ground in a satisfactory manner. In October, some seed of *Trifolium alexandrinum* (Berseem) clover was sown out and germinated well. It commenced to die out when the dry weather set in. It is likely that this clover, which is supposed to help in preventing malaria, will do best in wet places.

Potatoes in Variety Trials and for Bulking.

(Chart No. II).

The seed of ten varieties of potatoes which are immune to wart disease were imported from Scotland in the spring of 1927. They were immediately planted on arrival and proved to be a real asset to the industry. That season, 942½ loads (of 60 lb.) were either sold or issued for bulking. During the short rains of 1927-28 and the long rains of 1928 variety trials were planted with the ten new varieties, using local British Queen as the control in the former and Arran Victory as control in the long rains. The method adopted was to use three rows of each variety, and planted between them and on the flanks were sets of three rows of the control. For the yields, only the centre rows were weighed and compared.

The short rains were below average and none of the varieties did well. British Queen was the most outstanding in its behaviour. It was the only variety which has been acclimatised for some years and made a great appearance of leafage, but when harvested the potatoes were all chats and only fit for pig food. During the long rains this variety was

almost the heaviest yielder but had again a large proportion of culls and chats. It goes to prove that potatoes are most likely to depreciate in quality if grown for a number of years in Kenya.

Arran Consul and British Queen were the latest varieties by a good many days, and the former appears to be the least suited to dry conditions of all the newly imported varieties. Kerr's Pink stands first as a yielder and in every way it is a most excellent potato and can be recommended with confidence. Majestic has been noticed to make very slow growth to start with and in many cases, in the farms and in the Native Reserves, it has germinated badly.

Number of loads sold in 1928	166
Number of loads issued free in 1928	51
Number of loads issued for bulking in 1928 ...	3

Coffee Variety Plots.

Much of the work conducted in these trials was performed under the guidance of the Senior Coffee Officer and will be reported by him.

Wild Silk Plantation.

The pupae in the silk nests were parasitised in 1927 and only a very few groups of caterpillars were seen feeding in 1928.

Sweet Potato.

Planting trials were laid down in the big rains of 1927 and again in 1928. The varieties used were Munere and Uganda. The planting methods were as follows:—Vines were used for propagation and were planted (1) 2 ft. apart on top of drills 3 ft. apart, (2) Vines planted 2 ft. apart in rows 3 ft. apart on the level, and (3) Vines planted at random on the level about 3 ft. apart (native method). The yields of the 1927 trials are given in Chart No. III.

Sweet Potato Varieties.

The following varieties are being multiplied and may be used later on for variety yield trials: (1) Uganda, (2) Jersey Yellow, (3) Nancy Hall, (4) Minyogo, (5) Uganda (small leaved), and (6) Costa Rica.

Groundnuts.

The following varieties were planted in 1927 for observation in yields and behaviour. This crop is not a success at the Scott Agricultural Laboratories, and it is thought that the elevation is too high. They remained on the land too long and the yields were poor and unreliable.

(1) Spanish Bunch, (2) Imperial Spanish, (3) Natal, (4) Java White, (5) Jumbo, (6) Spanish Bunch, (7) Virginia Runner, (8) Virginia Bunch, (9) Virginia Bunch (S.R.), (10) Native (local), and (11) Kavirondo.

Yerba Mate (*Ilex paraguayensis*).

The original trees continue to produce healthy growth and are now 6½ feet high, at 3 years 9 months from seed.

Mtama—Kikuyu White—Planting Trials.

An experiment was laid down in the Native Demonstration Shamba at the Laboratories with four 1/14th acre plots of mtama and planted by the following methods :—

(1) Check row system. Holes for seeds 3 ft. by 3 ft. apart.
(2) Rows 3 ft. apart and seed in bunches 1½ ft. apart in the rows.
(3) Rows 3 ft. apart and seed scattered thinly in the rows.
(4) Broadcast at 5 lb. of seed per acre.

The best result was attained with No. 1 and the next by No. 3 as recorded below :—

No.	Seeding per Acre	Duration of Crop	Yield per Acre	Remarks
	lb.		*lb.*	
1	3	296 days	1,120	May be cleaned in two directions.
2	4	,,	756	Ought to give higher comparative yield.
3	4½	,,	1,043	May be easily cleaned.
4	5	,,	931	Cleaning cannot be done during growth of crop.

Manuring Experiment.

In conjunction with the Assistant Agricultural Chemist a manurial experiment was carried out. The results of this are embodied in a separate report now being published. This experiment is being continued and extended.

Soya Bean Variety Trials.

More varieties as understated were imported, and trials with this crop were continued. All varieties which were tried in the past were a complete failure and have rarely returned as much seed as was planted. Out of the varieties tried this year only two were worth any consideration, and were " Dixie " for seed purposes, and a Rhodesian variety (large chocolate-coloured seed) might yet be useful as a green manure.

Varieties tried :—Virginia, Manchu, Tokio, Dixie, Laredo, Chiquita, 2 Rhodesian varieties, 3 Uganda varieties.

No bacterial nodules formed on the roots and it is thought that this is the chief controlling factor. Liquid cultures are being sent from America to inoculate the soil with.

Lucerne Variety Trials.

Ten imported varieties were sown out in April. Germination was perfect, but a torrent of rain washed through the beds and damaged them to a certain degree. Blanks were beaten up during the short rains. Observations were taken of the behaviour of varieties and are recorded below in their order of merit. Weighing records will commence in 1929.

		Origin.
1. Cape Province ...	100% ...	South Africa.
2. Hairy Peruvian ...	100% ...	Washington, D.C.
3. Hunter River	95% ...	Australia.
4. Kansas Common ...	80% ...	Washington, D.C.
5. Dakota Common (F.C. 14173)	78% ...	,,
6. Dakota No. 12	75% ...	,,
7. Utah	72% ...	,,
8. Ladak	50% ...	,,
9. Ladak (F.C. 14135)...	50% ...	,,
10. Grimm	45% ...	,,

Buckwheat.

The two varieties (1) American (acclimatized), and (2) Polish, were planted in 1/16 acre plots for comparison :—

No.	Name	Duration in days	Yield per Acre	Remarks
			lb.	
1	American ..	103	2,151	A good crop and best suited to most purposes.
2	Polish ..	82	900	Formed a poor struggling growth and has little to recommend it.

Permanent Rotation Trials.

A series of 34 1/10-acre beds were plotted and planted in April in a system which will test out a number of two-season and four season schemes of rotation of crops. The beds have been intersected and one-half of each had had an application of lime at the rate of one ton to the acre. While most of the beds will receive no manure, others will get periodic dressings of farmyard manure, green manure or Seychelles guano. Records were made of the behavious of the crops in each of these plots and yields taken. It is not proposed to publish these records yet, as they would convey very little information, but as time goes on it is expected that some real useful rotations will be demonstrated.

Wheat.

Throughout all the experiments during the long rains where this crop had to be sown, Kenya Governor was used exclusively. The crops were good and gave returns up to 12 bags (of 200 lbs.) of grain per acre.

B.286c Wheat.

During the short rains fully 6½ acres of this new variety were planted with a 32 lb.-per-acre seedling. The rains were good and at the end of the year the crop looked extra well and will enable us to make a liberal issue to the suitable wheat-growing areas.

Sugar Quarantine.

A strong thief-proof boma was erected and 18 imported varieties of cane were planted out in it. These are at present under observation. The Mycologist will report upon them.

Miscellaneous Crops.

57 crops were sown for observation and bulking. Some of these were varieties of lupins, vetches, peas, cow peas, pigeon peas, beans, crotalarias, etc.

99 sowings were made in the seed beds, which included trees, coffee shade and shelter belt trees, vegetables, coffee varieties and selections, clovers; *A triplex* varieties Old Man and creeping; Kudzu vine, etc. Many of these were transplanted to seed trays and banana pots and issued to those who were advised or wished to try them out.

Poultry.

This side of our activities was greatly increased and a new area of four acres was laid aside for poultry runs. During the year a number of pens were constructed and fitted with houses, a brooder house, an incubator house, and a large number of hutches and cold brooders were also made. In the near future it should be possible to produce a continuous supply of young well-bred birds for the improvement of the poultry in native areas.

Diseases and Insect Pests.

The crops have been very free from injurious pests throughout the year.

Weeds.

These have caused little trouble on account of the long periods of dry weather.

Work Oxen.

There were 17 work oxen at the end of the year and all in healthy condition.

SEED AND PLANT ISSUES.

Maize—White Pearl	425 lbs.
,, Miscellaneous varieties ...	52 samples.
Field Peas	358 lbs.
Beans—Canadian Wonder	1611 lbs.
,, Miscellaneous varieties ...	6 samples.
Buckwheat	600 lbs.
Njahi Beans	95 lbs.
Wheat—Kenya Governor	2720 lbs.
Grasses	54 samples.
Coffees	10 samples.
Clovers	13 samples.
Green Manures	103 samples.
Pop Corn and Sweet Corn... ...	2 samples.
Saltbush	18 samples.
Lucerne	31 samples.
Groundnuts	2 samples.
Kudzu Vine	12 samples.
Edible Canna	4 samples.
Bananas	70 roots.
Gliricidia muculata	95 large cuttings.
Mulberry	485 cuttings.
English Potatoes	13,200 lbs.

It is felt that the farmers could benefit to a much greater extent if they could be encouraged to visit the Scott Laboratories more often and take advantage of the seed and plant samples which have been collected and produced for them.

GENERAL.

I should like to express my thanks for the co-operation and interest taken in the work by some members of the farming community, and also to my fellow officers who have assisted me throughout the period under review.

Wm. LYNE WATT.
Assistant Agricultural Officer.

CHART No. 1.

FORAGE GRASS TRIALS AT SCOTT AGRICULTURAL LABORATORIES.

Plot No.	NAME	Origin and Date when Planted	Distribution in Kenya	Total of three weighings Green Fodder per acre. 1928	Average Annual yield Green Fodder per acre	Remarks
				Tons	*Tons*	
1	*Melinis minutiflora*—Molasses grass	South Africa 28–4–25	Very little	28·65	29·92	Imported from South Africa. Is eaten readily by cattle after they get used to it. Propagate by seed, roots or cuttings. One of the best drought resisters.
2	*Pennisetum*—probably ciliare..	Voi 1–5–28	Plentiful in warm places	4·00	..	Value not yet known.
3	*Cymbopogon afronardus*—Buffalo grass	South Kukuyu 2–4–25	Plentiful	32·41	32·25	Can reach 7 feet high. Young leafage is greedily eaten by stock and horses. Propagate by roots. Very drought resisting.
4	*Themida triandra*—Oat grass	South Kikuyu 2–4–25	All over Highlands	17·20	13·19	About 3 to 4 feet high. One of the best grasses in natural pastures. Makes good hay.
5	*Sorghum rigidifolium* ..	South Kikuyu 6–4–25	Sparsely	32·16	27·12	Usually found in swampy places in forest land. Height 5 feet. Propagate by seed or roots. Good drought resister. Stock do not care much for it.
6	*Hyparrhenia rufa*	South Kikuyu 6–4–25	Fairly common	32·70	23·15	About 6 feet high. Young leafage relished by stock and will make good hay. Propagate by roots. Very good drought resister.

CHART No. 1.—(*Contd.*)

FORAGE GRASS TRIALS AT SCOTT AGRICULTURAL LABORATORIES.

Plot No.	NAME	Origin and Date when Planted	Distribution in Kenya	Total of three weighings Green Fodder per acre. 1928	Average Annual yield Green Fodder per acre	Remarks
				Tons	*Tons*	
7	*Brachiaria soluta*	Mt. Kenia 1–5–28	Limited	..	..	Planted May, 1928. Not yet established. Established by roots or seed.
8	*Setaria aurea*—Golden Timothy Grass	South Kikuyu 20–4–25	Very plentiful	21·38	18·87	Height 4 feet. Horses and cattle thrive on it. Propagate by seed or roots. Very good drought resister. One of most common grasses in natural pastures over 6,000 feet elevation.
9	*Brachiaria brizantha*	South Kikuyu 20–4–25	Well distributed. Fairly uncommon	28·09	26·10	Height 3 feet. Rank spreading growth. Stock relish it when young. Easy and rapid to establish by roots or seeds. One of the best drought resisters and keeps green throughout dry season.
10	*Panicum maximum.* Guinea Grass	South Kikuyu 20–4–25	Well distributed. Common	17·47	17·19	Height 5 feet. A coarse grass, easily propagated by seed or roots. Cattle and horses thrive on it. Fairly good drought resister.
11	*Paspalum scrobiculatum. Var. commersonii*	South Kikuyu 20–4–25	Well distributed Uncommon	18·91	16·76	Recumbent growth of a few inches high. Easily propagated by seed or roots. Good drought resister.
12	*Panicum trichocladum.* Karia Grass	Upper Ruiru 26–4–28	Very uncommon	10·90	..	Behaviour and feeding value not yet known.

CHART No. 1.—(*Contd.*)

FORAGE GRASS TRIALS AT SCOTT AGRICULTURAL LABORATORIES.

Plot No.	NAME	Origin and Date when Planted	Distribution in Kenya	Total of three weighings Green Fodder per acre. 1928	Average Annual yield Green Fodder per acre	Remarks
				Tons	*Tons*	
13	*Paspalum dilatatum*	South Kikuyu 20–4–25	Fairly common	10·83	10·14	Full height 12 inches. Eaten readily by cattle and sheep. Good drought resister and keeps green throughout the dry seasons. Seeds sparsely, and should be established by sub-division of its fibrous roots.
14	*Pennisetum ciliare*	Athi River 20–4–25	Very common	20·50	18·31	Spreading type of leafage. Stands 1½ to 2 feet high. Makes very good hay. Weathers during drought. Stock like it.
15	*Penicum meyerianum.* Athi Grass	Athi River 2–11–27	Uncommon	20·80	..	Spreading rampant growth 3 feet high. Stock are not very fond of it. Easy to propagate by seed or roots. Good drought resister.
16	*Panicum coloratum*	Athi River 2–11–27	Uncommon	22·52	..	Height 3 to 4 feet. Very good drought resister. Most suitable for hay of all grasses tried yet. It is one of the most outstanding grasses in the trial plots. Propagate by seed or roots.
17	*Pennisetum sp.* near *P. riparium*	Uplands 20–4–25	Very uncommon	10·08	10·58	Low spreading growth 1 foot high. Cattle eat it. It is not a grass which can be recommended.

CHART No. 1.—(*Contd.*)

FORAGE GRASS TRIALS AT SCOTT AGRICULTURAL LABORATORIES.

Plot No.	NAME	Origin and Date when Planted	Distribution in Kenya	Total of three weighings Green Fodder per acre. 192[illegible]	Average Annual yield Green Fodder per acre	Remarks
				Tons	*Tons*	
18	*Leptochloa obtusiflora*	Voi 20–4–25	Uncommon	8·22	7·85	An ornamental grass. Stands 2½ feet high. Readily eaten by stock. Sparse leafage. Not recommended.
19	{ *Cynodon dactylon.* Naivasha Star Grass *Trifolium johnstoni.* Kenya White Clover	South Kikuyu 2–2–27	Very common in Highlands	24·09	25·04	Both have a very spreading habit and soon cover the land with a dense growth. A good mixture for stock, and if regularly grazed the clover will compete. Makes first class hay.
20	*Amphilophis pertusa*	Athi Plains 20–4–25	Very common	17·71	14·35	Three feet high. Stock thrive on it. Forms much seed and fairly easily established. Excellent hay.
21	*Chloris gayana.* Rhodes Grass	Athi Station 29–11–27	Uncommon	25·9[illegible]	..	Three to four feet high. Easily established by sub-division of roots. Spreads rapidly One of the best grasses for the Highlands.
22	*Echinochloa stagnina*	Kikuyu 26–4–27	Uncommon	4·90	..	Not yet established. Value has yet to be determined.
23	*Setaria plicatilis*	South Kikuyu 29–11–27	Scattered	18·54	21·23	Grows to about 4 to 5 feet high. Cattle like it. Propagate by roots or seed. Good drought resister.
24	*Echinochloa pyramidalis* ..	South Kikuyu 29–4–26	Common in wet places	13·36	13·91	Grows to 5 feet high. Though a river type it resists drought well. It is not recommended.

CHART No. 1.—*(Contd.)*

FORAGE GRASS TRIALS AT SCOTT AGRICULTURAL LABORATORIES.

Plot No.	NAME.	Origin and Date when Planted.	Distribution in Kenya.	Total of three weighings Green Fodder per acre, 1928	Average Annual yield Green Fodder per acre	Remarks.
				Tons	*Tons*	
25	*Pennisetum clandestinum.* Kikuyu Grass	South Kikuyu 26–4–28	Very common	5·84	..	Forms a dense creeping growth, 1 to 2 feet high. Spreads by underground rhizomes One of our best grasses to plant for pasture Establish by planting roots at elevations over 5,000 feet.
26	*Paspalum notatum.* Paraguayan Paspalum Grass	Paraguaya 23–4–25	Only being tried	7·69	..	Introduced during recent years by M. A. D. Le Poer Trench. It is a low creeping grass and spreads by thick underground rhizomes. Does not establish so quickly as Kikuyu. Strongly recommended for sheep.
27	*Perhaps Phalaris sp.* Canary Grass	Tanganyika 1–5–28	Not yet established	..	..	Value not yet determined.
28	*Eragrostis paniciformis* ..	Nairobi 23–4–25	Uncommon	9·57	9·85	Grows to a height of 2 to 3 feet. Not recommended.
29	*Cynodon Dactylon.* Naivasha Star Grass *Trifolium johnstoni.* Kenya White Clover *Pennisetum clandestinum.* Kikuyu Grass	South Kikuyu 2–2 27	Very common ..	13·34	14·05	A most palatable mixture. Does well if well grazed, but if allowed to grow to hay the clover will be suppressed first, and the Kikuyu later. Very good in drought.
30	*Sporobolus filipes*	Nairobi Dist. 23–4–25	Fairly common	17·10	9·91	Stands about 4–5 feet high. Forms an abundance of very fine seed. Propagate by roots or seed. Leafage very similar to Guinea Grass (No. 10). Very good drought resister.

CHART No. II

IMPORTED POTATO VARIETY TRIALS.

No.	Variety	1927–1928		1928		Average of two Ssaeons	
		Order of Merit	Yield per Acre.	Order of Merit	Yield per Acre	Order of Merit	Yield per Acre
			Cwt.		*Cwt.*		*Cwt.*
1	Kerr's Pink ..	186·3	60·9	112·7	75·5	149·5	68·2
2	Arran Victory	178·3	58·2	100·0	67·0	139·15	62·60
3	Arran Consul..	153:1	50·05	46·4	31·1	99·75	40·57
4	Rhoderic Dhu..	150	49·83	98·8	66·19	124·40	57·61
5	Great Scot ..	145·3	47·40	122·8	83·3	134·05	64·85
6	Majestic ..	132·9	43·48	87·8	66·2	110·35	54·84
7	Golden Wonder	124·5	40·86	70·9	47·6	97i70	44·23
8	Arran Comrade	115·9	37·93	66·9	44·8	91·40	41·36
9	Abundance ..	110·6	36·23	104·8	70·2	107·70	53·24
10	Ally	108·2	35·30	59·1	39·6	83·65	37·45
11	British Queen..	10 0	32·69	154·6	103·6	127·30	68·14

CHART No. III.

SWEET POTATO TRIALS.

Two Varieties by Three Methods.

Planted .. 21–4–27 Harvested .. 3–2–28

Period on the ground .. 288 days Elevation .. 5,800 feet.

Rainfall .. 14·35 inches.

Variety	Vines planted on ridges 3′ × 2′	Vines planted on the level in in lines 3′×2′	Vines planted Kikuyu met od on level at random
	Per acre	Per acre	Per acre
	lb.	*lb.*	*lb.*
1. Uganda—			
Vines ..	10,240	10,560	13,440
Potatoes ..	17,600	17,120	16,960
2. Munere—			
Vines ..	9,520	15,520	14,400
Potatoes ..	12,480	16,160	20,800
Average of the two varieties by the three methods of planting—			
Vines ..	10,030	13,040	13,920
Potatoes ..	15,040	16,640	18,880

It was anticipated that the yields from ridged plots would have yielded better than from plots on the level, the trials proved otherwise. This peculiar re ſu lt may have been due to the unusually dry year.

CHART No. IV.

IMPROVEMENT OF NATURAL PASTURE TRIALS

28 yards

12 yds.

1 Native Manure 4 tons 16 cwt. per acre.	2 Control	3 Lime 1 ton per acre.	4 Control	5 Seychelle (Phosphate) 303 lb. per acre	6 Control	7 Ammonium Sulphate (Nitrogen) 151 lb. per acre
8 Control	9 Native Manure and Lime	10 Control	11 Native Manure and Seychelle (Phosphate)	12 Control	13 Lime and Seychelle	14 Control
15 Amm. Sulphate and Seychelle	16 Control	17 Amm. Sulphate and Lime	18 Control	19 Amm. Sulphate and Lime and Seychelle	20 Control	21 Native Manure and Amm. Sulph and Lime and Seychelle

In each plot the same weight of each constituent was used.
Each plot is 4 yards by 4 yards.—1/303rd acre.

APPENDIX L.

REPORT OF THE ASSISTANT AGRICULTURAL OFFICER, SOUTH KIKUYU, 1928.

Staff.

The agricultural work in this reserve was under my own control for the whole period now under review.

The native staff consisted of ten trained instructors, two of them being permanently stationed at the school at Scott Agricultural Laboratories.

Travelling.

One thousand nine hundred and eighty-seven miles were travelled; 50 days were spent in the Reserve.

Rainfall.

The climatic conditions change greatly with the altitude, and in consequence it is difficult to give exact figures. The lower elevations up to 6,500 feet had about 32.52 inches, and the higher places up to 8,000 feet had about 43.56 inches. The rains were late, and badly distributed throughout the year, and rather upset the work of these primitive people. The year started badly with dry hard weather for the late 1927 plantings, and several areas, especially around Dagoretti, were almost under famine conditions. Though the long rains were almost normal in quantity, they were heavy while they lasted, and a long dry period resulted during the development of the crops. The short rains commenced rather late, but were very good and will most likely produce satisfactory crops for the early 1929 harvest.

Mission Schools and Out-schools.

A certain amount of time was devoted to examination of the work of these centres. A very distinct advance has been made during the year in their agricultural teaching, *e.g.*, the Church of Scotland Mission near Kikuyu is devoting a considerable amount of time to this side of the teaching, and large areas in the Mission land are under first-class school gardens, where the pupils are taught all the practical side of the subject.

Jeanes School, Kabete.

Weekly visits were made to this educational centre up to the first week in April, and lectures and demonstrations were given.

Native Agricultural School, Scott Agricultural Laboratories.

In residence :—

Wakikuyu	35
Embu	6
Wakamba	4
Kamasai	2
Masai	1
Total ...	48

Eight boys completed the three-years' course during the year.

Four trained boys were transferred to the Plant Breeding Station at Njoro, three are instructing in the Native Reserves, and one has become a Chief in Embu.

The work undertaken by the apprentices was performed efficiently and willingly. Several passed the Government vernacular examination, and towards the end of the year five of the senior boys entered for the Government "C" examination. Their work in school has given satisfaction in all subjects including agricultural lectures, English, writing, arithmetic, geometry, surveying, hygiene, geography, and nature study.

The type of boy now entering the school is a great improvement on what was possible some years ago. The educated class are now keen to take up agriculture as employment and make most intelligent workers.

Each pupil has a school shamba, and devotes part of his own time to it. The class of work performed in this part of the school land is very creditable indeed.

Barazas and Demonstrations in the Reserve.

These numbered 91. This is exclusive of the Native Agricultural Instructors.

General Survey.

There was a decided shortage of food in most parts of the district in the early months of the year. The long-rains crops were not too good and the permanent crops such as yams, bananas and sweet potatoes made rapid development after the short rains came, and greatly relieved the food shortage. The cultivation in native shambas is greatly improved when compared with past years. Many more are digging before planting, and inter-crop cultivation during the dry weather is being taken up more whole-heartedly.

One of the greatest hindrances to high yields is the overcrowding of crops. This is almost universal, and where the density of plants is too thick by many times it is impossible to conserve enough soil moisture to produce anything to harvest. Repeatedly one can see cattle in distress for food, while the maize crops would benefit greatly by thinning.

As time goes on the natives become more used to our presence in the reserve and are less suspicious. Only the real pagans trouble us, as they appear implicitly to believe the inexactitudes told them by the agitators. If these anti-Government workers could be suppressed, there is little doubt that our progress would be more rapid and very helpful to the natives.

The work of demarcating the reserve boundaries is well in hand, and when this is finally completed the natives are expected to become more settled.

Stock.

The cattle, sheep and goats have been healthy throughout the year in most areas. There was a distinct shortage of grass and water in the Limuru and Uplands locations about January and February, and around the former place a large number died of thirst and starvation. Water was introduced to the Ndeiya grass lands, and will give some temporary relief. The number of animals continues to increase as the natives become wealthier. Meat-eating is becoming more popular with them, but in most cases the cattle are bought from the European farmers, and their own flocks are not being reduced in numbers as was expected at one time.

Milk and Ghee.

The milk trade is on the increase, but it is still of little consequence. Very little ghee is made.

Trees and Wattle Industry.

There is some increase in the proportion of land under timber. In the early part of the year the sale of wattle-bark—dry and green—was started, and a very large tonnage was sold from all parts of the reserve where wattle had been planted. This has encouraged planting very considerably in all elevations, but it is welcomed most in the places over 6,500 feet, where timber was scarce.

One small area alone sold during the months of July to November, inclusive, 736 tons of green bark, which gave £2,208 in return. Some of the dry bark which originated from this reserve reached the foreign buyers in very bad condition. The natives may be to blame to a certain extent, but

it is believed from what has been seen that the fault lies almost entirely with the local buyers. Every effort was made to teach the natives how to strip and cure the bark, but that alone will not improve the present condition of the industry.

Maize.

The crops of the 1927-28 short rains were almost a complete failure. Maize in the long rains did better than was expected, perhaps due to the high proportion of early-maturing types which are used in the reserve. The 1928 short-rains crops are likely to yield good harvests.

Wheat.

Since Kenya Governor was procured by a limited number of the shamba workers the crop has gained popularity, and many small patches were seen during the year. It will become an important crop in elevations which are too high for the millets.

Millets.

Rapidly losing popularity, and are being replaced by potatoes, beans, peas and wheat.

Beans.

Slow progress is being made with pure samples. Good markets could be secured if clean, pure, and beetle-free seed were sold.

Field Peas.

A most useful early crop in these short-rain places, especially in elevations over 6,500 feet, where it enjoys the cold. Large quantities were sold in a ready market.

English Potatoes.

Much of the crop is self-sown, and still remains free from disease. There were an increasing number of well-planted shambas, which handsomely repaid the workers for their extra labour. "Majestic" was issued to selected growers, but it is now found to be unsuitable, and will have to be replaced by some other variety of a distinct type and suitable to the local conditions.

Yams.

The large areas in the Mukinyi district were almost killed out by mealy bug in 1927, and have not been replanted again with this crop.

Insect Pests, etc.

Stalk Borer.—Very considerable loss was caused to maize and mtama in the long rains. Some areas counted had as much as 50 per cent. infection. Control measures were taken, and it is thought that this action is largely responsible for the improved conditon in the short-rains crops.

Locusts.—Flying swarms visited the district, but caused little damage.

Wild Pigs.—One of the Native Agricultural Instructors spent several months in endeavouring to eradicate this pest in the high elevations near the forest.

Waggons, Carts, Implements and Maize Mills.

The increase is sufficiently rapid to be satisfactory.

Hide and Skin Drying.

Considerable efforts were made to replace the old methods of drying the hides and skins in the sun by advising the natives to commence more thorough cleaning and shade drying. Very little real progress was apparent.

Poultry.

There has been little change. There were no severe outbreaks of Kikuyu fowl disease. A great number of natives are becoming interested in procuring better birds and many also are improving their housing and endeavouring to keep them clean.

Seed, etc., Issued in South Kikuyu Reserve.

Beans	1,621 lb.
Peas	14 lb.
Potatoes	3,000 lb.
Maize	33,410 lb.
Njahi	90 lb.
Wheat (Kenya Governor) ...	1,210 lb.
Fruit trees, etc.	28.
Lucerne samples	25.
Bananas (roots)	42.
Cockerels (R.I.R.)	157.
Pullets (R.I.R.)	108.
Eggs	22.

I should like to express my thanks to the District Commissioner and his staff, who have so ungrudgingly helped in forwarding the movement.

W. LYNE WATT,
Assistant Agricultural Officer.

APPENDIX M.

REPORT OF THE AGRICULTURAL OFFICER, NYANZA.

Staff.

At the commencement of the year Mr. P. Booth, Agricultural Officer, was in charge, assisted by Assistant Agricultural Officers N. D. Spranger and R. G. Bentall.

The station was handed over to Mr. A. G. Bailey, Agricultural Officer, upon his arrival on 1st February.

Mr. N. D. Spranger left Bukura on 5th February.

Mr. R. G. Bentall has been stationed at Bukura during the whole of the period under review.

Native Agriculture, North and Central Kavirondo.

Crops.

With certain exceptions, namely towards the north-eastern portions of North Kavirondo, all crops have given excellent returns.

Food Supplies.

Food supplies should be adequate to maintain the people until August, 1929, when supplies from the new crops will become available.

Stocks at the end of 1927 were below normal and while no acute shortage was experienced in 1928, food supplies were expensive toward the lake shore. In the north and north-eastern portions of North Kavirondo maize meal was purchased by natives at the rate of Sh. 20 to Sh. 26 per bag. No famine relief measures were necessary.

Considerable quantities of maize were shipped from Kisumu to Samia, and sold to natives after being ground into meal.

To guard against famine, it is advisable that the planting of muhogo and sweet potatoes be extended in both North and Central Kavirondo, and especially in those areas where the rainfall is uncertain.

Weather Conditions.

The rainfall was very favourable for both long- and short-rain crops.

For native methods of cultivation it was ideal, but for the European practice of clean cultivation, weed growth was difficult to handle. Throughout the growing season rain fell nearly every afternoon between 3 and 5 o'clock.

The heavy precipitations from March to June were not altogether favourable to beans, but mtama and maize and especially the former made excellent growth.

The rainfall was adequate for short-rains crops from September to the end of the year, and in many locations the best crops for the past five years were reaped.

Hail caused considerable damage during July and August.

It may be mentioned that the continuance of hail into October often determines the date when short-rain crops can be planted in these areas.

Seed Issues.

Numerous issues of seed free of charge were made to natives. The Local Native Council Central Kavirondo contributed £100 towards the purchase of seed and an equal sum was provided by the Department of Agriculture for further supplies.

Issues were made as follows :—

	Maize	Simsim	Groundnuts	Beans	Gram
	bags	*bags*	*lb.*	*lb.*	*lb.*
CENTRAL KAVIRONDO					
Asembo and Uyoma ..	..	..	12,600	..	..
NORTH KAVIRONDO					
North Kitosh	100	20	..	..	..
Miscellaneous Locations from Bukura ..	90	5	2,640	200	150
TOTAL ..	190	25	15,440	200	150

There was an increasing demand for supplies of vegetable seeds, and the planting of crops such as carrots, cabbage and peas has been fostered with the object of increasing the output of saleable produce, and also for the variation of the diet of the people.

One-quarter of several of the demonstration plots was planted with vegetables to demonstrate that they can be grown successfully.

Maize.

Yields have been extremely good for both long and short rain crops, and in some locations were described as "bumper."

A large exportable surplus has come forward for export (see Railway returns).

The quality and productive capacity of much of the Kavirondo maize has improved vastly during recent years, and funds expended on flat white maize for distribution as seed has proved a good investment. Maize from the Maragoli country where large issues were made in 1927 is far superior in quality to that of Asembo and Uyoma, and other locations bordering the lake in both North and Central Kavirondo. A distribution of maize as ample as funds will allow is planned for Asembo in 1929.

Prices of maize ranged from 15—20 lb. for Sh. 1 from January to September, and 30—35 lb. from September to the end of the year. The production of maize is limited by transport costs to areas within reasonable distance of the railway, but with the establishment of the Yala railway, it is anticipated that the output of North Kavirondo will increase.

Mtama.

The crop was a record one, and all sections of the native community were well pleased with the results of this, their principle article of diet.

Many varieties are grown—possibly twenty ranging in colour from very dark brown to white. Some varieties are grown in a few locations only, while others are more widely dispersed.

Groundnuts.

In former years considerable interest has been shown in this crop, and as shown under " Seed Distribution," 12,800 lb. were issued in Asembo and Uyoma. The crop from Asembo amounted to 3,600 bags and sufficient seed should have been reserved for 1929. Yet to maintain this output, a further issue of seed will be essential. The people cannot resist the temptation of delving into their own seed supplies and eating them prior to planting time.

Methods of harvesting have not improved, and it is considered advisable to introduce legislation prohibiting the purchase of groundnuts prior to a certain date. Competition in buying among Indians owning shops is very keen, and groundnuts harvested immaturely find a ready market. When stored in bulk immature produce rapidly becomes musty, and having a bad reputation on the market, prices for produce from Asembo Bay are low. Waste in crushing is also very considerable, the quality of the oil poor, and the content low.

By the lake shore, groundnuts mature in five months. If planted at the end of February they are ready to lift at the end of August. The date suggested for buying to commence is September 1st.

It is also suggested that the rules enforce adequate protection from weather for groundnuts during transportation, and that the quality be maintained by storage under suitable conditions.

If planted in March at Bukura, this crop is not ready to lift until December or January—a period of 10 months—and is not profitable for either natives or Europeans at an altitude above 3,800 feet.

Pulse.

Beans.—The rainfall was heavy for beans prior to September, but both beans and chiroko gave very satisfactory yields from then on to the end of the year.

The 1927 crop was sparse owing to the partial failure of the rains towards the end of that year, the prices have ruled high, as much as Sh. 22 per bag.

Kisumu merchants create a good market for this class of produce, as they enter into contracts for supplies to the railway and to Europeans owning farms.

Supplies needed by contractors engaged on the new Kisumu-Yala line may tend to maintain prices again in 1929.

Gram.—Gram (*Cicer arietinum*) is imported in quantity from India at the present time for consumption by Indians. This crop appears to withstand the heavy rains experienced from March to July, and trials have been carried out on demonstration plots with fairly good results. As the plant is a legume and succeeds in wet weather when other pulses fail, an endeavour is being made to extend its cultivation.

Kavirondo gram is not equal in quality to that grown in India, but a ready market awaits all that is produced.

Simsim.—This crop is planted twice in the warmer, dryer areas, and once only in the higher locations.

The quality of the seed is fair only, being small and rather uneven in sample.

Areas planted have been equal to if not in excess of those of past years, and good yields have been recorded.

The people plant simsim with a heavy hand, and it is surmised that if one-half the quantity of seed was sown on the same area and the spacing between plants wider, that the plants would be more branched, and in consequence the yield better, and ripening more uniform.

Agricultural Implements.

Owing to decreased output of produce caused by inadequate rainfall in 1927, sales of agricultural implements and labour-savings devices decreased somewhat in 1928.

The following sales were made in Kisumu to natives :—

Separators	67
Churns	41
Ploughs	104
Trek Chains	233
Yokes	110
Plough Shares	129
Millstones (sets)	3

Increased sales are anticipated in 1929.

Produce Surplus to Local Requirements.

The following produce, most of which was grown in the Nyanza Province, was booked from Kisumu station :—

	Tons.
Maize	9,916
Maize flour	830
Sisal	31
Beans	128
Coffee	134
Groundnuts	138
Simsim	329
Rice	112
Other grains	747
Hides	956
Goatskins	63

The following produce was shipped from Lake Ports of Kenya to Kisumu :—

	Tons.
Cotton	136
Cotton seed	99
Simsim	567
Maize	1,911
Maize flour	223
Groundnuts	2,279
Hides	136

Cotton.

1927-1928 *Crop, Prices.*—Buying commenced on January 10th, the price for 1st Grade at the ginneries being Cts. 21, and at buying posts Cts. 20 during January. Where competition was keen the price remained at Cts. 20, but elsewhere in February it dropped to Cts. 17, and Cts. 6—8 was paid for dirty cotton.

Conditions.—Owing to dry conditions prevailing during August, September and October, 1927, the cotton plots were stunted, and lacked fruiting branches. In consequence the yield per acre was extremely low. A certain amount of damage was done by hail.

Sales.—Cotton sales were as follows :—

	Seed Cotton.
	lbs.
Malikisi	
B.C.G.A.	189,922
Nambare	
Folkes and Co.	41,233
Lukolis	
B.C.G.A.	53,027
Small and Co.	181,459
Folkes and Co.	69,705
Busia	
Small and Co.	61,729
Folkes and Co.	84,614
Andungusia	
Small and Co.	34,766
Folkes and Co.	47,474
Matayos	
Small and Co.	35,746
Folkes and Co.	57,916
Kailail	
Small and Co.	39,701
B.C.G.A.	194,176
Lukwakas	
Small and Co.	32,527
B.C.G.A.	99,422
Total seed cotton	1,402,922

1928-1929 *Crop.*—Propaganda for the purpose of encouraging natives to increase the acreage planted, began at the end of February.

The standard of planting and subsequent cultivation has improved considerably this season. This is very marked in the Samia location which was one of the most backward areas last season.

Weather conditions have been favourable throughout the cotton area, although some damage was done by hail at Lukolis, and heavy rain caused damage to flowers and bolls in mid-December around Malikisi, and North-East Wamia. The prospects for the crop are very good, and an output much exceeding that of last season is anticipated.

Distribution of Cotton Seed.—One hundred and fifty tons of cotton seed were distributed in May, and ten tons in June were distributed as follows :—

Distribution Centre	Tons	Ginnery Supplying	Total
			Tons.
Samai Ginnery	30	Samia	50
Matayos	10	,, ...	
Marach	10	,, ...	
Nambare Ginnery	20	Nambare	55
Lukolis	15	,, ...	
Unisarus	5	,, ...	
Busia	5	,, ...	
Lukolis	5	Uganda Seed ..	10
Wamia	5	,, ,, ..	
Malikisi Ginnery	30	Malikisi Ginnery ..	50
Kailait	10	B.C.G.A.	
Lukwakas	10	,, ...	
Central Kavirondo (various) ..	5	Samia	5
Total Seed Cotton distributed			170

Agricultural Instruction in Native Reserves.

The policy of providing agricultural instruction in native reserves was continued. Officers of the Administrative Department have included agricultural subjects for discussion at barazas, and officers of this Department have utilised this means of contact with natives for the dispersal of agricultural information.

Twelve native agricultural instructors—with demonstration plots—have been engaged on this work throughout the year.

The Department of Agriculture has provided funds for the following locations, namely :—

Central Kavirondo { Nyahera, Malango, Luanda, Samia (C).

North Kavirondo { Broderick Falls, Tiriki, Lukolis (c), Malikisi (C).

At the request of the Local Native Council, Central Kavirondo, the number was increased by four in Central Kavirondo, and funds for the payment of salaries were provided by the Council.

New plots were opened up in the following locations in compliance with this request at the following centres, namely :

South Gem, South Ugenya, Seme and Sagam.

These employees have carried out all manual labour for the plots, which are the first charge on their time. The plots being in order in all respects, they have toured their respective locations, advising and assisting those requiring their services. They have also visited Mission out schools and provided instruction for teachers and pupils in the planting of crops and the maintenance of school gardens.

Although engaged by the District Commissioner, on behalf of the Local Native Council, the instructors newly engaged have been supervised from this station, which organisation has proved satisfactory in practice.

Plots in the cotton area marked (C) have been devoted almost exclusively to the demonstration of improved methods of cotton production with emphasis on correct spacing of plants, thinning and cultivation.

Other plots have been worked on a four-course rotation extending over two years.

As is customary, numerous obstacles have been encountered and but little encouragement received from natives. Visible signs of progress are few except in the cotton area. In many places cotton is now planted in lines, and a certain degree of success attained.

Work in native areas was apportioned as follows :—

Mr. A. G. Bailey supervised Central Kavirondo and small portions of North Kavirondo other than where cotton is grown.

Mr. R. G. Bentall conducted instruction in the cotton areas, extending throughout from Port Victoria to Malikisi.

Grain Storage.

Vermin and insects of every description cause very serious loss to natives by consuming and damaging grain in native food stores, and there is an excellent opportunity for Local Native Councils or the Department to assist natives by providing instruction in the building of better grain stores. Model grain stores if built at demonstration plots or other approved points by the roadside, would help very much in this respect.

Pests and Diseases.

Stalk Borer.

Stalk borer is prevalent in Kavirondo, and does much damage to mtama and maize. Being partial to it as a host plant, mtama suffers more severely than maize.

The higher locations towards Maragoli are less affected than the lower areas.

The Provincial Commissioner is very interested in this subject, and the desirability of the application of rules under the Diseases of Plants Prevention Ordinance was considered. Prior to such application a survey of all locations over an extended period is essential, and staff not being available for this purpose, it was not possible to proceed with the matter.

Locusts.

North and Central Kavirondo have been fortunate in having escaped visitation by locusts.

Mosaic Disease of Sugar Cane.

The uprooting of diseased and of soft varieties of sugar cane continued during the year. The people of Alego suffered the greatest loss in this respect. By the end of the year infected areas were almost clear of the disease.

Striga Weed.

It was stated by Europeans resident in Kavirondo for many years, that this parasite is more prevalent than formerly. Natives fail to realise its importance, and although they are aware that it is labour wasted to plant badly infected land, yet they are reluctant to carry out orders for its eradication. Several prosecutions were carried out in Central Kavirondo for its suppression, but as such measures to reduce it would have involved a large percentage of the population, it was not possible to proceed further in this manner.

Native Agricultural School, Bukura.

The number of apprentices at the school has averaged thirty-six throughout the year.

For the purposes of instruction the boys were divided into three classes : A., B. and C.

One of the foremost objects of the training has been the building up of character, instilling the sense of discipline and the habit of work. The undesirability of becoming "koranies" and that manual labour is honourable has been stressed upon every suitable occasion.

The only change of note in the school has been that the time spent in school by apprentices was reduced from sixteen hours during working time to eight hours, and that night school was instituted on five nights each week from 6.30 to 8 p.m. Thus apprentices have received instruction in the theory of agriculture and in school subjects for eleven hours weekly, *viz.*, one session each day either in the morning, afternoon or evening.

Instruction.

Practical.—Instruction in all forms of farm work by manual methods and the use of farm implements has been imparted. All operations from the preparation of the land to the harvesting of crops. Improved methods which natives are able to adopt in their native reserves have been demonstrated, and the major operations on the farm have been carried out on these principles. Labour-saving devices are also employed to demonstrate their possibilities and advantages. Nursery work is also taught.

The elder boys are placed in charge of squads to instil a sense of responsibility, and to teach and accustom them to the charge of labour.

Demonstrations were given on the land at the various stages of development of the crops.

The practice of allotting a school garden of 1/20 of an acre to each apprentice was continued. The produce of the plot is the property of the owner, and assists in augmenting the food supplies of the boys.

Three prizes were awarded at each of the long and short rain seasons, marks being awarded each month or at suitable intervals. No instruction was given in the planting of these plots, and the practical ability of each boy and the success of agricultural instruction was, to a certain extent, gauged by the methods employed. Also a sense of healthy rivalry was furthered, and the discussion of agricultural matters encouraged.

Results have shown that boys who gain the higher places in school subjects are also towards the top of lists for success with school gardens, but that this is not always so.

Theory.

Theory.—The principles underlying cultural operations, the theory of soils, planting, harvesting of crops, animal husbandry, poultry keeping, Ki-Swahili, arithmetic, writing, geography and hygiene.

At the commencement of the restriction of school hours, I was of the opinion that the time given to school subjects was insufficient to equip boys for duty as native agricultural instructors, but experience has shown that at the conclusion of their training, boys are able to keep diaries for the purpose of recording their work and movements, and to receive written orders in the field.

If employed as native agricultural instructors, this standard of training is adequate. It has been clearly demonstrated that if the standard of their training enables them to undertake work

as clerks, there is a strong tendency to drift off into service other than that of Government for which the training is intended, as the remuneration is higher.

Fouth Year of Training.—If the training is intended to equip apprentices to pass out qualified to undertake work as teachers of elementary agriculture in normal and village schools, then the training in school subjects is inadequate, and a fourth year of training is essential with not less than nineteen hours school work each week.

The policy of giving additional instruction for a fourth year was tried in 1927-28, and four boys were selected for the purpose. One year may be a brief period over which to try this experiment, but the results obtained have shown that considerable caution is necessary in the extension of this system.

Of the four boys only two have proceeded to work of the nature intended. One is giving satisfaction at the C.M.S. Mission School, Maseno, and another has proceeded to Jeanes School, Kabete, for training as a teacher for a further period of two years. This will enable the latter to obtain a knowledge of teaching methods and a status. The remaining two have obtained work as clerks on European farms.

FARM—BUKURA.

Weather Conditions.

Rainfall for the year			Inches.
1928	...	...	48.29
1927	...	...	39.68
1926	...	...	65.05

As stated under the heading " Native Agriculture ", the rainfall has been more than adequate, and has been well distributed.

Crops produced during the year will be adequate for food supplies for apprentices and labour during 1929.

Also as shown under the head " Seed Distribution ", seed was grown for distribution to natives.

Certain crop trials were undertaken, but owing to lack of uniformity of fertility of soil, yield trials of varieties were discontinued. Gram and njahi were tried for the first time with very fair success.

Njahi planted in August looked very promising during the early stages of growth, but gave a small crop only. Further trials will be conducted with this crop during 1929.

Natives are anxious to copy Europeans in planting wheat, but in 1928 as in former years the results obtained with this crop were poor. From these, and from results obtained on demonstration plots, it is considered inadvisable to encourage natives of Kavirondo to attempt to grow wheat, as disappointment will ensue.

A. G. BAILEY,
Agricultural Officer.

APPENDIX N.

REPORT OF THE ASSISTANT AGRICULTURAL OFFICER, COAST AREA, 1928.

Staff.

1 relieved Mr. H. J. Taylor on September 1st, on which date he proceeded on leave.

The native staff was as follows :—

Mombasa.—1 instructor, 1 apprentice.
Malindi.—4 apprentices.
Kilifi.—2 instructors, 8 apprentices.
Digo.—1 apprentice.

Their work has been assisted on occasion by casual labour. There was some increase in staff at the beginning of the year, but this was not too satisfactory. Until there is a proper training centre for the apprentices on the Coast, the work done by the native agricultural staff will not be thoroughly satisfactory. They seem to take no natural pride in the demonstration shambas they have charge of, and unless closely watched the amount of work they do is negligible.

Correspondence.

362 inward letters; 405 outward letters.

During the year many letters of an advisory nature were written, apart from correspondence with Government departments and on native agriculture.

Weather and Rainfall.

1928 was a very dry year on the coast.

The opening months of the year were dry; light showers fell in March, but these were local, heavy falls being registered in some places, whilst at others, a short distance away, the fall was very light.

The long rains broke in May, and were general throughout all districts. These rains continued well into June. The month of July was disastrous from a crop point of view. The rains failed, and for most of the time a heavy dry wind was blowing.

August was fairly dry, a few light showers falling; September was also dry.

The short rains started at the end of October, and fell at intervals during November and the beginning of December; from reports they were well up to average.

Travelling.

3,676 miles were travelled by motor-car—2,009 miles by Mr. Taylor and 1,667 miles by Mr. Oates.

161 days were spent in the Native Reserve—119 days by Mr. Taylor and 42 days by Mr. Oates.

Both in the case of Mr. Taylor and the writer, this number would have been greatly augmented but for attacks of fever and other incidents which occurred to upset plans made beforehand.

Crops.

Maize.

This crop proved to be either a partial or a total failure during the 1927 short rains, crops of any size being obtained only on the Sabaki River, the Chonyi Ridge, and Kaloleni.

The Long Rains.—Where it was possible for maize to be planted in March, good crops were obtained, at such places as Kaloleni, Sabaki River and Mirima. In these places the crops had rain during April, May, and June. In other places planting did not start until May, and the crop was for the most part a failure.

The maize was given a good start by the May and June rains, but the July monsoon dried everything to such an extent that the stalks shrivelled up, and the cobs were very small and dry.

Short-Rain Crop.—The short rains did not break until late in the year. When they did start, however, the rainfall was very fair. At the time of writing, crop prospects are good, one good shower being needed to fill out the cobs.

Stalk borer seems to be on the increase in the coast area. A vigorous campaign was carried out to ensure the burning of old stalks during October and November, and in most cases this was done. It is, however, very hard to get the coast native to do anything without sitting over him while it is being done.

General.—Maize being the chief food crop of the coast and back districts, a considerable part of the Department's activities in the Coast Province conerned that crop.

Issues of seed were made to most districts, and only the bad year prevented a very distinct advance being made in maize-growing on the coast. As it was, the drought caused the crop to be a poor one, and only in a few places was the variety of maize in use materially improved.

At Mirima, in Digo District, the seed issued was planted early and had good rains, and a particularly good crop resulted which greatly impressed the local natives.

In Malindi district the seed issue was mainly used in planting the seed farm at Kakoneni.

With the energetic assistance of the District Commissioner some 200 acres of land was planted up, the object being to show the natives on the Sabaki how maize should be planted, and also to have a good seed supply for next year to be distributed to the people concerned. Unfortunately, owing to the dry season, the crop was a failure.

Prices.—Owing to the shortage of food the Kilifi and Malindi Districts were closed for food export most of the year. Prices ranged from 12 pichies (pichie=6 lb.) for Sh. 2 in the outlying places such as Kakoneni, to 6 pichies for Sh. 2 at Mariakani and Rabai. In Malindi and Kilifi there are no markets in the back country, and if the people do get short of food they have to buy back what they have sold to the Swahili duka keepers at twice or three times the price.

A great deal of good would be done if the system of native markets in vogue in the Kikuyu country could be introduced.

Cotton.

At the beginning of the year pickings for January and February were very small owing to lack of rain.

The total pickings for the 1927-28 crops were as follows :—

	Malindi.		*Mambrui.*
A.	60,808 lb.	...	64,868 lb.
B.	4,009 lb.	...	1,448 lb.
C.	5,108 lb.	...	10,123 lb.
	69,925 lb.	...	76,439 lb.

Total all qualities : 146,364 lb. seed cotton.

Ginned Cotton.

A.	130 bales.	...	37,440 lb. nett.
B.	17 bales.	...	3,580 lb. nett.
	147 lb. lint.		41,020 lb. lint.

Lint percentage : 28.02.

The Assistant Entomologist and Mr. Alfieri, of the Egyptian Department of Agriculture, visited Malindi and Mambrui during January. Shipments of material containing Pink Boll Worm Braconid parasites were made to Egypt; some of this shipment subsequently found its way to the Sudan. Parasites were shipped in special boxes, and kept in the cool chambers of the various ships. They reached their destination

safely. The parasites have been bred successfully under laboratory conditions, and were introduced into the fields during August and September.

Samples of ginned cotton have been shipped to Egypt and the U.S.A. for examination and report.

1928-1929 *Crop.*—Seed from the first picking, first quality of the 1927-1928 crop was carefully kept and the germination per cent. for this seed was 79 per cent. in 8 days, as against 60 per cent. in 1927. The approximate area planted was just over 1,000 acres, showing a small increase on last year. The crop received a very good start, and it looked as if a very good crop would be obtained. Unfortunately, as reported elsewhere, the months of July, August and September were very dry, and the cotton was starved for rain just at a time when a good shower would have made all the difference.

Picking started very early this year, and most of the people around Malindi and Mambrui were ready to sell their cotton early in October.

The total yield was first estimated at 100 bales; however, good short rains in November and December have given the crop an almost 50 per cent. increase.

An encouraging feature for the future is that a Mr. A. Tetzner of Kilifi produced some 20,000 lb. of seed cotton on his shamba this year, and intends to increase production during 1929.

It was found necessary to institute proceedings against 26 shamba holders under Kenya Cotton Rules (1923). The natives do not appear to have yet realised the necessity for these rules, although Agricultural Officers have held frequent barazas on the subject during the last three years.

Insect Pests.—The 1928 crops have been fairly free from pests. *Celeckia Gosoypiella* (Pink Boll Worm) was present, but the Braconid parasite kept it under control.

Dysdercus sp. (Cotton Stainer) was present and did some damage.

Coconuts.

The planting of coconuts by natives continues to increase rapidly.

The production of copra does not increase, and there is no doubt that the primary object in planting coconuts is for tembo production.

Copra production from European estates again shows an increase owing to fresh areas coming into bearing.

Simsim.

This crop continues to gain in popularity on the coast. Free issues were made during the year, and in spite of the severe drought good crops were reaped in some places. There was quite a demand for it during the 1928 short rains, and in some cases natives went many miles to obtain seed. Prices ranged from Sh. 50 to Sh. 60 per jizila (185 lb. approximately).

Rice.

Both Upland and Swamp rice are grown on the coast. At Vanga swamp rice did very well; it is hoped to work out an irrigation scheme during the next year.

If this can be done the yield will be greatly increased, and with good water control, two crops in the year should be grown.

Canadian Wonder Beans.

This is a crop which has rapidly established itself in the favour of the coast people. Its quick-growing properties often ensure a yield when other crops fail.

In 1928 seed was bought by the Local Native Council in Digo, Kilifi, and Malindi Districts.

In 1929 its distribution will be further increased.

Kunde and Pojo.

These old-established crops of the coast did well in the drought year, giving crops in some areas where very little else grows.

Cassava.

This is the real stand-by in the case of drought and famine on the coast.

There are many varieties planted by the natives, and it is hoped to collect varieties for trial and analysis.

Cassava appears to be a crop which might have possibilities if something definite were known about yield, etc., on the coast.

Coffee.

The coffee planted on the coast for experimental purposes has not done too well.

At Kwale, where it has been treated well, all varieties have prospered.

Tobacco.

Experiments in the growing of this crop were carried out but were not successful, owing chiefly to the dry weather. The following varieties were planted at Mambrui and Sokoke :—

1. Hickory prior.
2. Kentucky yellow.
3. Conqueror.
4. Nyasaland Gold Leaf.
5. Warne.

The native crop failed in many parts, but at Kaloleni and Rabai good yields were obtained.

Seed Issues.

Kilifi.

Maize : 40 bags bought by Local Native Council.
Beans : 23 loads Canadian Wonder.
Beans : 23 loads Rose Coco.
Chillies : Half bag, free issue.

Digo.

Maize : 30 bags Local Native Council.
Beans : 5 loads Canadian Wonder beans.
Beans : 5 loads Rose Coco.
Simsim : 15 bags, free issue.

Malindi.

Maize : 20 bags Local Native Council.
Beans : 9 loads Canadian Wonder.
Beans : 7 loads Rose Coco.
Chillies : Half bag, free issue.
Simsim : 14 bags free issue.

Lamu.

Maize : 15 loads, free issue.
Simsim : 4 bags, free issue.

Kipini.

Rice : 1 bag free issue.

Poultry.

During the year two issues of Rhode Island Red cockerels were made to the Coast.

40 to Vanga in Digo District in October; and
40 to Sokoke in Kilifi District in December.

All these birds and those issued at Mariakani in 1927, have done well, although some of the latter have died. These issues are greatly appreciated by the natives on the coast, and enquiries have been made from all parts of the province as

to when the next issue is to take place. Kilifi Local Native Council has voted a substantial amount for the purchase of further supplies.

Hides and Skins.

During the year a determined attempt was made to get the natives of the coast to take an interest in the correct way of flaying and curing hides and skins. Demonstrations were given at various points and every effort was made to get people to do things in the right way. Results were not, however, in proportion to the trouble taken. The coast native is quite willing to attend a demonstration, and will appear to take an intelligent interest and agree with the demonstration. This unfortunately is as far as the majority go; only too frequently one sees a native, who has agreed with everything the demonstration has shown the day before, with a skin pegged out in the full glare of the sun.

Agricultural Shows.

Owing to the dry season it was impossible to hold the agricultural shows on the coast which had been arranged.

I attended the agricultural show in Nairobi on October 2nd and 3rd. A representative exhibit of coast products was staged. A number of coast natives, who were in Nairobi for H.R.H. the Prince of Wales' visit, attended the show, and were greatly impressed with what they saw.

Communications.

On the whole there was a decided improvement in the roads on the coast during the year.

Owing to the food shortage, there was less traffic than might have been expected; this was largely due to district export having been stopped.

The Sabaki stone bridge scheme was not carried out. It is, however, understood that it will be built this year.

Conclusion.

Progress is still being made. Things, however, move very slowly. The coast native is not used to doing things in a hurry, and it is only by years of constant teaching that any great change will be effected.

Owing to bad rains and damage done by locusts, the whole province will have a hard time in the early part of 1929.

It is hoped that there will be good rains in order that the population may be able to take full advantage of the seed that is being issued.

It is by introducing good seed and teaching better cultivation that real progress will be made.

Owing to the proximity of Mombasa, living is too easy in many places, hence the production is but a small part of what it should be.

While it is essential that the food crops be encouraged, there is room for a real revenue-producing crop, one that could be grown over the whole province. It might then be possible to get the population out of their present hand-to-mouth existence.

Finally, I should like to thank all Administrative Officers on the coast who have always been very ready to help and co-operate in many ways.

C. O. OATES,
Assistant Agricultural Officer.

COASTWISE TRADE (AGRICULTURE).

ARTICLE		EXPORTS FROM										TOTAL VALUE OF EXPORTS
		LAMU		MALINDI		KILIFI		GAZI		VANGA		
		Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	
			Sh.		*Sh.*		*Sh.*		*Sh.*		*Sh.*	*Sh.*
Maize	Cwt.	..	..	11,618	64,938	606	3,945	..	..	629	4,668	73,551
Rice	,,	667	971	4	37	..	..	..	..	53	1,666	2,674
Millet	,,	142	1,325	632	3,897	404	4,070	..	..	24	240	9,532
Other Grain	,,	..	..	9	66	..	..	..	..	17	257	353
Pulse	,,	1,257	26,863	21	246	..	..	..	..	..	8	27,117
Maize Meal and Flour	,,	..	..	7	70	..	..	..	..	..	..	70
Raw Cotton	Cental	307	8,169	358	33,191	17	560	..	..	..	..	41,920
Seeds, Cotton.. ..	Ton	1	495	24	2,877	..	..	..	..	..	..	3,372
Seeds, Sesame ..	,,	..	..	70	21,583	66	23,750	..	..	11	4,497	54,830
Copra	,,	219	86,169	22	7,180	260	125,740	9	2,595	112	42,033	263,717
Coconuts	,,	1	85	40	2,400	..	..	..	..	4	274	2,759
Sesame Oil	Gal.	2,216	9,571	4	20	..	..	..	..	..	..	9,591
Hides, Dry and Dry-salted	Cwt.	1,595	170,020	21	2,192	17	1,320	..	..	64	5,869	179,401
Skins, Sheep and Goat	No.	3,571	3,589	3,356	3,266	1,225	1,205	..	..	2,055	2,020	10,080
TOTAL VALUE.. *Sh.*		..	307,257	..	141,963	..	165,590	..	2,595	..	61,562	678,967

APPENDIX O.

ANNUAL REPORT OF THE ASSISTANT AGRICULTURAL OFFICER, EMBU, FORT HALL and SOUTH NYERI DISTRICTS.

For the year ending December 31st, 1928.

Staff.

Mr. G. Leckie was in charge of the agricultural work in the above-mentioned districts prior to my arrival. I arrived back from leave on October 10th and was posted to Embu, where I arrived for duty on the 17th, and took over from Mr. Leckie on November 6th, when he proceeded on leave.

Mr. Oates, prior to taking over the work in the Fort Hall District, was stationed at Embu assisting Mr. Leckie during January. In August he was transferred to the Coast Area.

Mr. Handley was stationed at Embu assisting Mr. Leckie during the latter half of April before taking over the work in the Meru District on the 1st of May.

The native staff under control for the year was as follows :

	Instructors.
Fort Hall District	6
South Nyeri District	2
Embu District	5
Labourers	6

Augmented at periods by a few part-time casual labourers. All such labour employed was paid from Local Native Council Funds, at the rate of Cents 40 per diem.

Travelling.

5,213 miles were travelled by motor car on duty, and 184 days were spent on *safari*.

Weather and Rainfall.

Embu District.—The 1927 short rains lasted till January and resulted in good crops of small grains. The rainfall at the intermediate elevations amounted to 12.77 inches.

Long Rains.—These were late in breaking and it was feared that they were going to fail. The rains finally broke over the greater part of the area under review on April 17th, almost a month late, and stopped in the beginning of June, when the weather became overcast and cold. In spite of these facts the long-rain crops proved a success, and good harvests were obtained.

Short Rains, 1928.—These were very late in breaking and the situation before they finally commenced was indeed critical. In the normal course of events these rains are expected to start early in October and continue steadily throughout the succeeding two months, whereas this year they did not commence till November 16th, in fact a month late, and abruptly ceased in the beginning of December. Since then with the exception of one or two very slight showers barely laying the dust no rain has been experienced.

Record of Rainfall.	1927. *Inches.*	1928. *Inches.*
January	.07	2.15
February	.14	—
March	9.81	1.89
April	6.18	8.99
May	2.73	10.27
June	2.08	.83
July	.43	.26
August	.49	.32
September	.42	.20
October	5.55	.93
November	3.79	7.80
December	1.28	.86
Total	32.97	34.50

South Nyeri District.—The long rains were adequate and the short rains, though late, were good. It is interesting to note that the northern part of the District had nearly fifteen inches more rain than the southern.

Record of Rainfall.	*Nyeri.* 1928.	*Keruguya.* 1928.
January	.85	1.97
February	.25	.34
March	1.41	3.30
April	16.35	6.99
May	13.60	9.975
June	2.36	3.08
July	.64	.92
August	1.58	.70
September	2.05	.17
October	10.23	6.61
November	2.68	2.935
December	1.29	1.56
Total	53.29	38.55

Total, 1927 : 31.51 inches.

Fort Hall District:—The long rains were almost exactly a month late, and the short rains three weeks late, thus although the rainfall was greater in quantity than in 1927, the resulting crops were not so satisfactory. In spite of the vast increase of native cultivation in the District, owing to the partial failure of the rains the year has not been a good one for native agriculture.

Record of Rainfall, 1928.

	Inches.
January	2.57
February	2.91
March	2.71
April	12.21
May	7.03
June	1.54
July	0.16
August	0.36
September	0.32
October	2.43
November	7.16
December	2.21

Total: 41.61 inches.

CROPS.

The short-rain crops harvested in February and March, were good, with the exception of maize. Millets and wheat were especially good crops and saved the situation in areas where food was scarce.

Maize.—The quality of seed throughout the Districts is steadily improving. Especially is this the case in Karatina area, South Nyeri, where a large issue of seed was made in 1927.

Wheat.—The Kenya Governor variety is proving reliable and is being extensively cultivated in the areas where it has been introduced. This is particularly noticeable in the Embu District. Apart from the trials in the Demonstration Plots there is to be found at least 250 acres of this crop. The cultivation of this crop though generally grown throughout the District is proving to be doing best in the higher elevations, *e.g.*, around and about Chuka division. No rust of any description has so far been noticed, and the crop is appearing to be distinctly healthy. The natives have adopted three methods of planting: 1, dibbling in rows; 2, broadcasting; 3, dibbling in holes same as millet. Of these three methods, rows naturally have proved the best, but as this involves a lot of extra work, broadcasting is undoubtedly the method the native should carry out.

Sim-Sim where introduced has proved successful, but the crop this year, due to the failure of the short rains, has to no small extent suffered, and it is feared very little of what has been sown will be harvested.

Beans.—This crop is being extensively cultivated and is becoming exceedingly popular with the native, especially the Canadian Wonder variety. The produce offered at the various trading centres shows a marked improvement in quality, and it is hoped that with one or two liberal issues of seed of the Canadian Wonder the ensuing produce will be of good and pure quality.

Field Peas.—This crop is becoming very popular and is being freely grown in most locations.

Groundnuts.—Experiments prove that this crop is suited to most areas, but due to the damage that is done by birds and squirrels the natives are making no efforts to grow the crop.

Castor Bean.—This is being cultivated and is proving suited to most areas.

Potatoes.—This crop is being extensively grown in the South Nyeri District.

Native Crops.

Njahi has been extensively planted in the Embu District as a remunerative crop and doing well.

Millet.—This crop throughout all the Districts is still the main crop and in spite of the partial failure of the rains is progressing very favourably, and good crops are assured.

INSTRUCTIONAL WORK.

In addition to instructions given by the Native Instructors, several *barazas* have been held and whenever possible individual instruction given at villages throughout the area.

DEMONSTRATION PLOTS.

Embu District, 19; South Nyeri, 2; Fort Hall, 22.

These plots are proving most helpful in attracting native attention, and it is interesting to note how readily the people situated near these plots are following the work and applying the methods to their own gardens. Whenever possible special instruction is given in crop rotation and manuring. The seed harvested from these plots is distributed to any native requiring good seed.

LIVE STOCK.

In Lower Emberre, rinderpest, pleuro-pneumonia and East Coast fever have caused considerable loss amongst the native stock.

Poultry.

The stock around and about Keruguya where 44 Rhode Island Red cockerels were issued has improved enormously. The natives are distinctly keen on this breed, and are prepared to purchase any R.I.R. strain when available from their neighbours who have been fortunate in receiving a free issue. The C.M.S. mission in this area are assisting with this good work, insomuch that they are breeding these fowls and are selling the young stock to the natives at a very low figure.

Implements.

Three " Iron Age " cultivators and seedling attachments are in use for demonstration purposes at the following places : Embu, Keruguya and Karatina. These implements are proving to be very useful, and it is hoped the natives will in the near future commence using them for their own cultivation.

In the Fort Hall District the natives are proving to be taking to the idea of using implements more readily than their brothers in Embu and South Nyeri Districts. No less than 16 small ploughs were purchased during the year and are now in use.

Seed Distribution.

South Nyeri District.

Groundnuts	60 bags
Field Peas	1 bag
Beans, Canadian Wonder ...	4 loads
Sim-Sim	2 loads
Vegetable Seeds	1 set
Wheat, Kenya Governor ...	10 bags
Linseed	3 loads
Maize	2 bags
Orange Trees	12
Lemon Trees	12

All the above supplied by the Agricultural Department.

Wheat, Kenya Governor ... 15 bags
Supplied by Local Native Council.

Fort Hall District.

Maize	100 bags
Wheat	20 bags
Beans	20 bags
Vegetable Seeds (value) ...	Sh. 300

Embu District.

Wheat	100 bags
Sim-Sim	200 loads
Beans, Canadian Wonder ...	5,000 lbs.
Field Peas	
Maize	

Export Returns.

Fort Hall District.

	Tons.	lbs.
Maize Meal	4,802 ...	1,996
Maize	4,599 ...	1,372
Beans	1,458 ...	935
Hides and Skins ...	49 ...	1,520
Grain	358 ...	1,995
Coffee	1,858 ...	573
Chillies	—— ...	1,172
Sisal	2,442 ...	1,204
Wheat	93 ...	1,641
Mawere	367 ...	1,120
Potatoes	28 ...	1,756
Wattle Bark	361 ...	673
Timber	1 ...	863
Fruit and Vegetables ...	7 ...	289

South Nyeri District.

Sagana Station—

Maize	1,808 ...	—
Maize Meal	3,390 ...	—
Potatoes	— ...	200
Beans	38 ...	—
Hides and Skins ...	8 ...	—

Karatina Station—

Maize	1,648 ...	1,060
Maize Meal	765 ...	1,400
Beans	250 ...	500
Potatoes	60 ...	—
Hides and Skins ...	20 ...	918

Hides and Skins.

Whenever possible instruction and practical demonstration have been given in skinning and shade drying.

AVERAGE MARKET PRICES.

Embu District.

Maize, per load ... Sh. 2 to Sh. 4
Beans, per load ... Sh. 2 to Sh. 4/50

South Nyeri District—as above.

Fort Hall District—as above.

INSECT PESTS.

In the Kandara region in the Fort Hall District, mealy bug is spreading and has already effected considerable damage to the yam crop.

Stalk borer is to be found, though so far to no great extent.

Grasshopper.—In one or two instances this pest has invaded wheat shambas in the Fort Hall District in large numbers and has damaged the crop.

Locusts.—Several swarms have passed over the areas under review, but have in no way caused any damage. Periodical searches have been made for eggs and hoppers, but as yet none have been discovered.

LOCAL NATIVE COUNCIL AGRICULTURAL VOTES FOR 1929.

Embu District.

	Sh.
1. Upkeep of Demonstration Plots and Purchase of Seed	1,800
2. Purchase of Agricultural Implements, and Working Oxen	500
Total ...	2,300

Fort Hall District.

1. Provincial Agricultural Show	5,000
2. Purchase of Seeds	1,500
Total ...	6,500

South Nyeri District.

1. Upkeep of Demonstration Plots and Purchase of Seed	2,000
2. Agricultural Show...	2,000
Total ...	4,000

The Local Native Council, Embu, voted Sh. 6,000 for the purchase of wheat and sim-sim seed. This wheat was planted in the Embu Division and the sim-sim was issued in the Emberre Division. Due to the partial failure of the short rains it is pleasing to know that at least half of the sim-sim issued in the Emberre Division has not been planted by the natives and is still in their possession, and it is hoped all of it will be planted in the long rains.

In attending the various Native Council meetings, attempts have been made to secure sufficient land from the natives to start " Seed Raising Plots "; the amount of land required would be approximately 30 acres in each District. The natives have declined to give up any of their land, and arrangements have been made with the Forestry Department to lease the required land in the Forest Reserve. A site for the South Nyeri District has already been selected and operations will commence at an early date.

Hilton Young Commission.

Mr. Leckie attended the Commission in February, at Nyeri, and explained the agricultural work and policy that is being carried out among the natives, further he accompanied Sir George Schuster and Sir Alfred Mant on a motor tour through the South Nyeri District.

Conclusion.

Natives are progressing in agricultural work and are becoming keen to learn improved methods. Relations with Administrative Officers have been most satisfactory and their co-operation much appreciated.

A. S. HARTLEY,
Assistant Agricultural Officer.

APPENDIX P.

ANNUAL REPORT OF THE ASSISTANT AGRICULTURAL OFFICER, MERU, FOR 1928.

Staff.

Until this year there has been no Agricultural Officer stationed at Meru, the officer from Embu visiting this district periodically in an advisory capacity. Mr. C. B. C. Handley, B.Sc., was appointed here on the 30th April, and was transferred to Nairobi on the 3rd July, when I took over from him.

The native staff for the greater part of the year consisted of three instructors stationed in Imendi. A fourth instructor arrived in September and was stationed in Tigania. In view of the large area which it is wished to develop, it is very desirable that this native staff be increased, as at present the large and fertile division of Igembe is untouched and the other divisions are understaffed.

Weather and Rainfall.

Long rains, 1928.—These were late in starting and were poor, only 14 inches of rain falling in place of 22 inches. This resulted in partial failure of crops, especially in the drier districts such as Tharaka, and pasture suffered very badly in Tigania.

Short rains, 1928.—These in this district are, as a matter of fact, the heavier of the two rainy seasons, and this year they commenced on the 24th October and plentiful rain fell throughout the Reserve until the 17th December. Crops are therefore well forward, and give promise of a good harvest.

Rainfall.—*See* Appendix.

Travelling.

I have travelled 1,513 miles by motor-cycle since July, and have been out of the Station for 71 nights in the Reserve and 6 nights in the Northern Frontier Province on Government service.

Crops.

1. *Maize.*—This crop grows well in nearly all parts of the district, either as a half-year crop in the lower parts or as an annual crop in the upper locations on the west. There is, however, at present very little maize grown, although the area is increasing as a result of the seed issues from Demonstration Plots. The maize grown on these plots has been good on the whole, the cobs being well made and filled. Native grown maize, on the other hand, is poor, both in quality and yield,

the cobs being very small, often not exceeding four inches in length on any one shamba. It seems very desirable that a constant supply of good seed should be available both by bulking on the Demonstration Plots and by large seed issues direct to the natives, so that not only may the poor strains be entirely replaced, but those natives who have not hitherto grown maize, may start its cultivation from the beginning with a pure strong seed. This is, in fact, essential if a maize export trade is to be built up in the Reserve.

2. *Beans.*—This crop is grown generally throughout the Reserve and is almost the staple food crop in certain parts, notably parts of Igembe. Native beans are very poor, being low yielding and mixed in sample, and the greatly superior Canadian Wonder are being introduced.

3. *Peas.*—This crop has been tried on Demonstration Plots with some success, but it has not yet been adopted by natives.

4. *Wheat.*—This crop grows very well at the Boma and in the higher locations on the west of the Reserve above 5,000 feet. Very good samples of plump and clean grain have been obtained from some of the Demonstration Plots, and some of the natives are taking up its cultivation.

5. *Millets.*—These are the staple grain crop of the great majority of the natives and very good returns are promised from the short rains, although in places they are not growing so well as neighbouring maize. It has also been noticed that they are badly attacked by locusts while maize is comparatively immune.

6. *Rice.*—This crop has been tried in a number of places. In Tigania on a swamp which dries out late in the dry season the land was not worked properly before the long rains, and as these rains failed, no crop resulted. In Imende, at Igani, in a river swamp well terraced, the rice gave promise of good crop, but what little grain set was eaten by locusts. At Mitungu on a small plot, the water supply failed, and the rice was too long without moisture to enable it to recover when the furrow was reconstructed. A large area was planted with Mwanza rice in the short rains at Mitungu, and this is dealt with more fully in the section " Commercial Shambas ".

Hill or Upland rice, it is believed, would grow well in the higher locations, but supplies of seed for experimental work are first required.

7. *Trees.*—Most of the Reserve is well wooded naturally. An Administrative Officer stationed for a time at Maua set on foot an afforestation scheme in Igembe.

8. *Insect Pests.*—With the exception of locusts, no insect pests of any importance have been reported.

8a. *Locusts.*—A flying swarm visited Meru in February and did considerable damage. Again in September and October flying swarms passed over the Reserve generally in a southerly or south-easterly direction. In December, yellow flying swarms visited the outlying parts of the Reserve and laying was reported at Mgombe Crater, and in the last weeks of December, the Assistant District Commissioner and the undersigned started destroying swarms of hoppers at Mgombe Crater and at Tharaka.

9. *Diseases.*

(*a*) *Plants.*—No plant diseases were brought to my notice during the year.

(*b*) *Animals.*—In June a number of oxen died from anthrax, which is somewhat prevalent in certain parts and in the boma.

10. *Demonstration Plots.*—With the arrival of an instructor who was appointed to Tigania, four new Demonstration Plots were started in that Division, and these with the old plots in Imende and a new one at Kitaugwa make at the end of the year a total of twenty-two. The crops grown on these plots are maize, wheat and beans, while peas, sim-sim and groundnuts have also been tried.

In another section it is suggested that the number of plots is inadequate and should be considerably increased.

Commercial Shambas.

During the year a scheme has been set on foot which, if successful, will undoubtedly cause a great advance in the agricultural development of this Reserve. This scheme provides for the breaking up of large areas of land by mechanical means by Europeans, and the planting and tending of crops by natives, both parties sharing in the returns obtained by selling the crops. Messrs. Young and Ayre, of Meru, entered into an agreement with certain chiefs and headmen, representing the natives, to prepare for planting certain areas of unbroken grass land, while the natives agreed to sow, cultivate and reap the crops, returning to Messrs. Young and Ayre 50 per cent. of the proceeds of the sale of the crops as payment for the ploughing operations. With the Northern Frontier Province adjoining this district it is anticipated that the whole of the crops will be bought by Government for use in the Province. Two areas of land were thus broken up for the short rains, 80 acres at Mitungu in Imende, and 90 acres at Oringu in Tigania. The former broke up under the plough very well, showing an easily workable soil of considerable

depth, and there are at a rough computation, four of five square miles of similar land at Mitungu which in the course of years should come to be a very productive native farm. The land broken up was terraced by natives and planted with Mwanza rice, which at that elevation (3,000 feet) should do very well, as there is an ample supply of water for irrigation. Some of the rice which the natives have been irrigating is at the time of writing looking very promising, and the land is practically weedless.

At Oringu the soil is not of the good quality of that at Mitungu and some difficulty was experienced in ploughing. Maize, wheat and beans were planted which with the favourable rains should produce a satisfactory return, although some seed was planted rather late.

Some difficulty has been experienced in the starting of this scheme, especially at Mitungu, where some of the natives are suspicious that they are being exploited. This suspicion the Administrative Officers have been at great pains to remove, and once a satisfactory harvest is obtained there should be no difficulty in continuing and developing slowly along the same lines.

Ghee.

Last year a ghee factory was established at Akithi in Tigania, owned and worked by the Local Native Council under European supervision. Owing, however, to the failure of the long rains and consequent lack of pasture, bulk receipts at the dairy became reduced to such an extent during August and September that it was decided to close down the dairy.

The choice of site for this dairy was not happy on account not only of this liability to water failure, but also of its distance from the boma, which made constant supervision by a European officer—which is essential—difficult and expensive of time.

The Akithi Dairy has therefore not been reopened, but the Local Native Council have built a new and better range of buildings on the Marania River, on the west side of the river, where there is a constant supply of water and grazing and the natives are definitely more pastoral than in Tigania. It is hoped to start business at this new dairy in January, 1929.

During the period when the Akithi Dairy was under my supervision the contributors were paid prices ranging from Cents 24 to Cents 32 per gallon of milk.

GENERAL.

Meru Reserve, eighty miles long, with its 160,000 inhabitants, its variety of climate and elevation from 2,000 feet to 7,000 feet, its plentiful rainfall and numerous streams and its very fertile soil, has a vast potential agricultural wealth. It must be remembered that from an agricultural standpoint, development has scarcely yet begun. The country is ripe for development, communications and transport are becoming easier, and many of the native chiefs are showing themselves willing to co-operate with the Administrative Officers in an agricultural policy which will lead to increased productivity and prosperity. Such a policy must be far seeing and consistent from year to year, and needs for its pursuit, an increase in the staff of native instructors and a judicious but generous expenditure of money.

At the moment there is little native-grown maize and such as is grown is of very poor quality. By increasing the number of Demonstration Plots where good methods of agriculture are used and good seed can be bulked and issued, and by making large issues of pure seed direct to the native, the poor maize can be entirely replaced and a profitable export trade can be built up in a few years. When the rail head is brought nearer to Meru an easy way will be opened to Nairobi and the Coast, and with the Northern Frontier Province close at hand, two markets will thus be available, which will be a further incentive to increased development.

I wish to express my thanks to the Administrative Officers for their assistance and co-operation.

W. O. SUNMAN,
Assistant Agricultural Officer.

APPENDIX I.

Rainfall, 1928.

	1928. Inches.	Average over a term of 16 years. Inches.
January	4.87	1.98
February	0.80	1.15
March	1.08	4.50
April	7.96	10.80
May	5.43	6.15
June	0.87	1.02
July	0.11	0.28
August	0.13	0.40
September ...	0.15	0.73
October	—	7.98
November	—	11.80
December	—	5.09
Total ...		52.28

APPENDIX II.

Seeds Received.

A.—From Agricultural Department, for long rains, 1928.

	lbs.
Maize (Flat White)	3,000
Wheat (Kenya Governor)	2,000
Groundnuts	200
Linseed	200
Peas (Field)	200
Peas (Senator)	60
Peas (Alderman)	60
Simsim	240
Rice (Maji Maji)	200
Rice (Sena)	1,200
Beans (Rose Coco)	300
Beans (Canadian Wonder) ...	300

B.—By Local Native Council Vote, for short rains, 1928.

	lbs.
Maize	6,300
Wheat	4,000

APPENDIX Q.

REPORT ON LOCUST INVASION, 1928, AND ACTION TAKEN.

Flying locusts were first observed in Kenya in 1928, about the beginning of February, and their presence was reported to the Department. In view of the then known occurrence of locusts in the Colony and their general behaviour, the Department was advised that egg-laying by the locusts was unlikely to take place here. Those flying swarms appear to have remained in the Colony about two months.

In March a notice was published as follows :—

"*Locusts*.—The Agricultural Department will be grateful for any information of the occurrence of swarms of locusts. Such information should include the exact locality in which they are noted, the approximate acreage covered by the swarms, whether hoppers or flying locusts, and the direction in which they are moving.

"It is particularly desirable that the breeding places be known in order that immediate measures may be taken to destroy the locusts at an early stage.

"Information should be sent immediately to the Entomologist, Agricultural Department, Nairobi."

Reports of egg-laying were received early in May from two places—Naivasha, on the farm of Mr. Gilbert Colville, and, subsequently, Gilgil, on the farm of the Hon. Galbraith Cole. The former first reported by telegraph, and the Entomologist was sent up to verify the report. Owing to the similarity of names, the wrong farm was visited, and a negative report rendered by the Entomologist on May 10th. On May 12th, a pamphlet by Mr. Wilkinson, Assistant Entomologist, was printed in The East African Standard, relative to locusts, their habits, and methods of control. Administrative and other Government Officers were circularised.

A supply of poison was moved up to Nakuru, and all spray pumps the property of the Department were overhauled and inquiries instituted as to the supplies of spray pumps available in Nairobi and at the Coast.

Locust Rules were drafted, considered, approved by circulation to the Members of Executive Council, and were finally published in the Gazette of June 5th. A copy of the approved and published Rules is annexed.

Mr. Beales on May 22nd reported the finding of eggs on his property, and he and his neighbour, Mr. Hewitt, commenced to hoe the ground in which eggs were known to have been laid.

On May 25th Mr. Blunt, Senior Agricultural Officer, proceeded to Naivasha and interviewed several farmers, particularly along the Morendat River.

In view of the fact that laying had taken place, provisional authority was secured to acquire further stocks of poison and pumps for use in the field. The suppliers of arsenic to the South African Government were cabled to prepare stocks for shipment, and one hundred locust pumps were ordered. At this time the Department controlled over three tons of arsenite of soda, and had nine large sprayers and twelve knapsack sprayers.

On May 28th, Mr. Blunt reported hatching at Gilgil, and thereafter hatchings occurred at Lower Molo and reports came in from Kerio Province. Hatchings then became general from the Kikopey River to Longonot and round Lake Naivasha. Meanwhile, or rather prior to this, hatchings had taken place in Turkana, and from the known furthest north hatching to the furthest south the distance was over 350 miles.

Mr. Blunt inspected the Solai and then the Lower Molo area where there were hatchings on High Rigg.

No reports of egg-laying had been received save those from near Gilgil, and the information pointed to a campaign on a small scale. Subsequently it was ascertained that eggs had been laid all round Lake Naivasha, at Longonot, in Lower Solai, in the Rift Valley, within Kerio Province, that is, over an area of some 50,000 square miles, of which the Department at this time had information relative to not more than 2,000 square miles.

On June 9th, a public meeting was held in Nakuru, when a resolution was passed in the following terms :—

> " This meeting accuses the Agricultural Department of grave lack of foresight and terrible negligence in dealing with the locust menace, and also considers the number of expert advisers quite inadequate to deal with so widespread a menace, and calls upon the Department to make adequate arrangements forthwith, and further, that this meeting desires to emphasise the necessity of dealing effectively with the locust menace in native reserves and unalienated Crown land as well as on settled land, and requests that thorough steps may be taken without delay to provide sufficient labour under competent supervision to deal with swarms as they appear, whether in reserves or on Crown land."

The Department had already taken steps to secure funds and supplies sufficient to destroy or cope with all hoppers in known laying areas, and preparations were in train. Locust Rules, which placed the onus for destruction of hoppers on

the occupiers of land, had been published a week before the meeting, and all the known means of destruction had been notified publicly one month before. The Department considered also that the destruction of hoppers where destruction was feasible and where crops were directly menaced by them, was all that could be done at this time. Action had not been taken to destroy hoppers or to cope with the pest in native areas; no reports of the presence of either eggs or hoppers in native areas had then come through. After the meeting Mr. Blunt proceeded to Kerio Province, and had reached Marrigat by the 22nd of June, and reported.

The Administration charged Mr. Champion, District Commissioner, with the duty of organising native effort in Kerio Province, where hopper areas had been discovered. This Officer was assisted by Mr. Blunt and three European temporary locust officers. A motor truck was provided and supplies of pumps, buckets, poison, tanks, and so forth, were at their disposal.

Attempts to enrol natives for work on hopper swarms in native reserves were made by Mr. Champion, but on account of the emptiness of that part of the country where hoppers occurred the number of natives secured was not great.

The undersigned proceeded before the middle of June to Naivasha and Gilgil to see what steps were being taken by occupiers to destroy hoppers in accordance with the Locust Rules, and in order to gauge the extent of the infestation and the scope of Departmental assistance which was required in that area.

Work was being done by Mr. Dempster on the Hon. Galbraith Cole's farm and by Mr. Gilbert Colville. Mr. Sunman, Assistant Agricultural Officer, was sent to assist Mr. Dempster, who had a formidable problem to tackle. The Nakuru farmers, particularly those in Lower Molo, were prepared to lend labour for destruction, but before arrangements to utilise their services could be made, a large flying swarm from the south entered the district, and in view of the uncertainty as to the arrival of more swarms from the same direction it was considered inadvisable to remove boys who might be needed for crop protection. The importance of the districts affected co-operating closely and contiguous districts organising to assist districts infested with hoppers is important, and is one of the ways in which simultaneous action may be taken throughout the Colony. A memorandum was presented on June 21st.

Mr. Mervyn Jones was requested to destroy hoppers on Sir John Ramsden's land, and he immediately put a large gang to work. The Department sent up tentage, poison, pumps, two travelling laboratories, drums, and so forth, to

Gilgil, and issues of poison and pumps on loan were made to several farmers in the district. Before the end of June the Department had secured further supplies of ten tons of arsenite, had twenty-eight portable sprayers, seven ten-gallon wheeled sprayers, five pressure drums and two high capacity manual sprayers. Two trucks were hired to transport spray material, water and so forth for use in this area. There was a native labour force numbering 97 boys, paid and fed by the Department, to deal with swarms in the Gilgil-Naivasha area. At this time, in addition to six officers of the Department, seven temporary locust officers were employed. Four motor trucks were bought.

In the Gilgil-Naivasha area, in addition to the operations conducted by Government staff, a number of farmers were doing excellent work in the destruction of hoppers.

Experimental work was undertaken on Sir John Ramsden's land to determine the correct strength for contact spraying, the use of admixtures as attractants, and the various forms of poison bait, chopped grass, horse dung, chopped hoppers, and so forth.

The late Dr. Claude Fuller, whose services were kindly loaned by H.E. the Governor of Mozambique, visited the area on July 13th, and expressed his satisfaction with the organisation and the methods that were adopted. The situation on July 14th, when Dr. Fuller addressed a meeting at Nakuru, was as follows :—

In Kerio, it was becoming obvious that the majority of hoppers would mature into fliers. The actual extent of the infestation in that Province will never be known. One temporary officer, Mr. Howitt, was working in co-operation with the native people in the Ndo River Valley, where there were large and numerous swarms. Mr Champion with Mr. Blunt, Mr. Davis and Mr. West was working in the Esageri, Marrigat, Hannington, Baringo area. This area is almost depopulated, and large gangs of natives were not to be procured in the district. The bush is frequently impenetrable, and spraying could be done only where the conditions admitted of it. Other methods such as driving were entirely dependent on conditions; it is not possible to drive locusts effectively amongst boulders and bush. Beating and baiting too were only partially useful. There were therefore a number of undiscovered or partially destroyed swarms which matured and subsequently caused loss in the Ravine-Solai area.

At this time, reports from Turkana indicated extensive maturing of locusts, and although equipment was taken up there was no opportunity for its profitable use. The small flying swarms found in Suk country came from the north,

mainly Turkana, where they had been born. The reason why the swarms in that district were at first small and separated by many miles was because of the very scattered and sparse nature of the food supplies in Turkana, which consisted chiefly of bush. There was little natural destruction of hoppers in Turkana on account of the almost entire absence of bird life. In Turkana itself, which was inspected by Dr. Fuller and Mr. Booth, Agricultural Officer, although only a few small swarms were seen, there was ample evidence that a very large area of the district had been infested with hoppers during the early part of the year. Large flying swarms came south towards the Kerio River, where young hoppers existed.

There appears no doubt but that the locusts collected in the Ndo Valley and above Baringo in great numbers. In the Nakuru-Longonot area there were hoppers which had hatched out about July 8th, and many much older hoppers. The most recent hatchings were on cultivated land in the vicinity of Crater Stream. On Wybrant's there were hoppers in the maize crop, and a small number in barley on Mr. Moberly's farm. An area of about three square miles on the Nakuru side of the white rocks on the farm of the Hon. Galbraith Cole was infested with young hoppers hatched on July 2nd, which were dealt with by beating, trapping, burying and finally spraying.

At the same time on the Gilgil side of the white rocks, hoppers were in the fourth moult and scattered all over a large area of bush and open grass. This necessitated constant moving about and also occasioned not a few surprises. On Soysambu, near Elmenteita, there was a moderate swarm which had to be dealt with, but at this time there was every indication that the severe Gilgil infestation was under control. The success attending early and late contact spraying with five-ounce poison gave every hope that the entire staff and equipment could be moved to Longonot in time to deal with the hoppers there before they matured into fliers.

This move was made on July 28th, the few hoppers remaining in the Gilgil area being dealt with by birds, which apparently cleared them up within ten days. At Longonot, as aforesaid, two officers had been working, and one spent four days on Loydien with boys and a truck kindly loaned by the P.W.D. For a day or two anxiety was felt regarding the partial failure of spraying. This was traced to the use of Naivasha Lake water drawn from the eastern end, where the oxidising power of the water was so great as to precipitate AS_2O_3 from the solution. At Loydien the water was satisfactory, as it had also been from time to time on Longonot Ltd. To discover this state of affairs and trace its cause entailed much testing, so that in all four days were partially lost. The

failure having been traced to the water, recourse was made to the railway tanks at McCrae's siding, where a large camp was erected. From this centre all infestations which were traced were dealt with. On August 20th it was difficult to find hoppers, but there were very small swarms of newly-fledged locusts. These were sprayed at night and in the early morning. Finally a swarm which when resting covered twenty acres of bush arose from the area, leaving a very small swarm of less than a quarter of an acre in Naivasha. This latter was partially destroyed by spraying one evening, and at 4.30 a.m. the large swarm was followed up the Kinangop to Mr. Knight's farm, where the edges of the swarm were sprayed. It was impossible to throw spray into the midst of the swarm owing to dense bush. At Loydien arrangements were made with Mr. Hopcraft to assist with natives by trampling with small stock in overcoming the swarms which were within or emerging from the bush. For a fortnight this gentleman did excellent work, until it was possible to detach a dusting party and one motor spraying party to the area, when the remainder were overcome within five days.

The work at Longonot was facilitated by the arrival of canisters of arsenite dust. This enabled every boy to kill over a large area, particularly if the air was moist.

In view of the fact that it is possible under certain circumstances to destroy parts of swarms of fliers, a short visit was paid to Olbanaita, but no flying locusts were encountered. Ravine was next visited, but the fliers were inaccessible, and departed over the hills to Nabkoi, where some of them fortuitously encountered hailstorms.

On August 29th the camp was broken up and the safari returned to Nairobi with equipment, one truck with poison equipment being left at Eldoret in case operations would have to be undertaken in that area in the near future.

I am pleased to say that with but one or two exceptions the temporary locust officers did their work well, and sometimes at considerable personal risk. The native workers were kept in good health, only minor contusions and small suppurations having to be dealt with. Whilst several officers were poisoned, there were no fatalities. Officers and the native agricultural pupils who formed the spray crews worked every day. Ordinary labour was given Sunday off.

During the time spraying was carried out there were no known fatalities amongst livestock, and remarkably few birds were poisoned.

It is opportune to mention the fact that although the pastoral farmers near Gilgil and Naivasha had not a great deal to lose if hoppers were not destroyed, a large number did very

good work indeed, namely, Hon. Galbraith Cole, Sir John Ramsden, Longonot Ltd., Mr. Hopcraft, Soysambu Estate, Government Farm, Mr. Hewett, Mr. Beales, Mr. Harvey, and several others. The Gilgil Farmers' Association employed a European and a number of boys to assist Mr. Dempster, Mr. Cole's manager, who had a very big problem to tackle, which he did with great energy.

Very helpful discussions in the field were held with the late Dr. Claude Fuller. Mr. C. B. Williams, Senior Entomologist at Amani, was given facilities to work on the locusts, a travelling laboratory being placed at his disposal. Discussions with him were at all times helpful, and it was a pleasure to co-operate with him and to have the benefit of his knowledge.

Expenditure on First Hopper Campaign.

Amount voted : £6,500.

A total expenditure of £6,515 was incurred on the first hopper campaign, distributed as follows :—

	Shs.
Salaries, travelling, etc.	35,620
Wages	6,991
Equipment.	
4 motor trucks	15,322
Upkeep, Petrol, etc.	4,524
Truck hire	5,755
Arsenite of soda (23 tons)	27,818
Tentage and camp equipment	3,643
Sprayers, pumps, drums, buckets	9,264
Other Expenditure.	
Carriage of goods	5,161
Telegrams	1,802
Honorarium, Dr. Fuller	2,011
Sundries	371
	Sh. 130,316

The area from Elmenteita through Gilgil, Naivasha, and round the Lake was thoroughly gone over, and the vast majority of hoppers were destroyed by the farmers and in conjunction with the locust organisation.

In Kerio, Njemps and Kamasia only were overlooked, and swarms which were accessible there were destroyed, as also those in the Lower Molo Area.

Flying swarms of some dimensions—the largest when resting covering nine square miles—did damage to European crops. The official estimate of damage done by these swarms is well under £30,000.

The hopper campaign came to an end on August 21st. Locust work did not cease, however. Reports were constantly arriving, chronicling the movements of locusts. One would take this opportunity of thanking all those who so kindly helped at this stage.

A report of the operations conducted, the various methods of hopper destruction which were tried, a note on flying swarms and their movements, and a series of notes on the control of locusts, were published in October.

Second Hopper Campaign.

By means of a study of the various reports of flying locusts received from the public and officers in the service, together with the examination of specimens forwarded, it was anticipated that laying would again commence in the Colony before the end of November. In order that the concentrations of flying locusts be observed and their maturity be determined, authority was sought, and four Locust Officers were appointed in October. These were distributed as follows : One at Marakwet, one stationed between Marrigat and Baringo; whilst two, under the control of Mr. Wilkinson, Entomologist, proceeded to Meru, and were stationed, one at the Barsaloi Road Drift on the Uaso Nyiro River, and one on the Garba Tula Road at the Mackenzie River crossing. The Stock Inspector at Isiolo was observing, and Mr. Sunman, Assistant Agricultural Officer, Meru, was also partially employed in observing. Advantage was taken of Mr. Gunn's (Research Officer) safari through the pastoral areas to make inquiries and observe from Thompson's Falls to above Rumuruti, to Meru, Embu, and finally into Kitui. Mr. Gunn had previous experience of working against locusts, and had a knowledge of their stages and structure.

As a result of preliminary observations, the information was gained that large swarms were rapidly nearing maturity in the Northern Frontier Province. On the 9th September, 1928, no eggs had been laid at Isiolo. The swarms in the Meru-Isiolo area were then immature. Scouts were sent out into the Samburu area to report when and where laying was taking place. Poison and supplies were sent to Barsaloi. Before the end of October and before laying had taken place, all scouting officers were in their respective areas observing. A proposed scheme was submitted for work against hopper swarms in the Northern Frontier Province, but on account of the lack of roads, other communications and water supplies,

the scheme could be adopted only in part. On 3-11-28, by means of the travelling laboratory sent up to Meru, it was possible to have dissections done on the spot, and it was hoped that the Entomologist would be able to investigate the behaviour of locusts as they neared the mating stage. On 5-11-28 reports of movements of a yellow swarm from Abyssinia above Moyale were received. On 8-11-28 an almost mature swarm, with females showing eggs well developed, was observed at Isiolo, as also swarms on the Mackenzie River. On 9-11-28 laying was reported from the Baisaloi Drift area. At this time, too, huge mature swarms moved towards Meru from the north-east out of Galla country, and travellers who had to pass the posts at the river crossings reported yellow swarms as being all over the Northern Frontier Province. Funds were provided for a campaign on a large scale. Provisional orders which had been placed for trucks, and other stores, *viz.*, 10 motor trucks, 1,000 locust pumps, 15 tons of arsenite of soda, were confirmed. Further orders were placed for eight motor trucks and 1,000 locust pumps. The nucleus of stores, pumps and so forth, was sufficient to see us through until the arrival of further stores. Difficulty was experienced in securing motor trucks with tanks in time, but little delay ensued on this account.

Breeding swarms were reported as being between Archer's Post and Merti, on 22-11-28 laying was reported from Bura on the Tana River, and the direction of movement of the main concentration of mature locusts was reported as being southwards. This meant that we could expect laying in Kitui and Ukamba generally, possibly all along the Tana River, possibly in the Masai Reserve and the coast generally. All stations and administrative posts north and east of Nairobi and in Tanganyika were warned to expect laying swarms early in November. Immature swarms were reported several times from Kitui in the latter part of October, and early in November mature swarms were reported. Laying was verified in Kitui on 12-11-28, and a subsequent laying took place early in December.

Along the main railway line mature swarms were reported at Kajiado, Daragani, and Voi in the middle of November, and warnings were sent out to expect more large swarms. Egg-laying was verified before the end of the month.

Malindi on the coast was warned to expect locusts from the west, and laying commenced on 26-11-28 on the Sabaki River. Laying swarms had also been seen moving in the Tana River District, no doubt depositing eggs. All natives were warned. In Kwale swarms arrived as expected, and laid, but not extensively.

Meantime in Kerio, in November, matters were progressing in much the same way. Nearly mature females were taken in Baringo on 23-10-28, and laying took place along the base of the Marmonet Escarpment about the middle of November. Laying swarms proceeded north, laying in Karpeddo; from Turkana and Suk laying was reported at the end of November, the laying areas between Marakwet and Lake Rudolph being known. Officers and others were busy discovering and marking laying areas. Thus at the end of November we were in possession of the information that very extensive laying had taken place in the Northern Frontier Province, some 95,000 square miles in extent, almost undeveloped as to roads and water supplies, and carrying a sparse and nomadic population; that laying had taken place in Tanaland, also thinly populated, at Bura, and suspected down the river to the sea; that laying had taken place over the whole of the Kitui District and on the Yatta, 18,580 square miles; that from Masongaleni to Voi, in the Athi River Valley, and south to the Railway, there was scattered laying; and that laying was taking place in Voi District, in the Sabaki River Valley, and down the coast.

In Kerio, 32,000 square miles in extent, laying had taken place in Baringo, Karpeddo, in Suk, and in Turkana. In short, some 160,000 square miles had been visited by mature laying swarms and laying areas could be suspected anywhere within that area. Efforts to discover and mark such areas were made until the arrival of hoppers, when operations for their destruction had to commence. Where the presence of population admitted of it, or where laying had taken place in cultivated ground, efforts were made to destroy eggs. This was done successfully in Kitui and in the Voi District, and at Kilifi and Malindi on the coast, but such work can be effective only under the best conditions.

On 11-11-28 the Chief Native Commissioner circularised all Administrative Officers to direct all efforts to stamp out locust hoppers, and to co-operate with the Department to the fullest extent. The responsibility for destruction in native areas lay with the Administration, the Department supplying equipment, transport and staff. The organisation adopted was that propounded in the memorandum on the control of locusts issued in October. The leave of Administrative Officers was deferred where necessary.

Locust headquarters were established on the Nairobi Showground (kindly loaned by the Agricultural Society), which was admirably suited for the purpose, there being a siding, office, storerooms, shedding, and so forth. A clerk-storekeeper was appointed, and the undersigned was charged with the duty of organising and placed in general control of the work.

Action was taken to enrol and train temporary locust officers. They were equipped with tentage and so forth, and paid £1 per day. A labour force was enrolled in readiness for any outbreak in uninhabited Crown land, such as Leroki, and a nucleus staff was retained at headquarters in order that at short notice a detachment could be sent out.

Power spray pumps were improvised from cheap Myers hand-pumps mounted on heavy boards. River pumps were also prepared and drums and half-drums secured for use as reservoirs at rivers and in the field near the hopper swarms. Any equipment which would expedite the lifting and transport of water for use in the field was secured and sent out; at the same time care was taken to have all equipment of the simplest possible nature, readily replaceable and convertible. Tank trucks were made by bolting ordinary 88-gallon drums, with taps and filler spouts, on to ordinary box trucks. Pumps, buckets and arsenite were despatched to Narro Moru for the Northern Frontier Province; to Kitui, to Voi, Mackinnon Road, Kilifi, Kipini, Ravine, Marakwet, and to Kitale for Suk-Turkana. Food supplies for natives were purchased and delivered where necessary, and where contractors were not available delivery was carried out by the locust section, a number of drivers being enrolled for the purpose.

Thus on the 23rd of November, the first batch of operating locust officers, fully equipped and provided with a truck, was despatched by road to Kampi-ya-Moto for work in Kerio Province, to prepare a base, mark laying areas, prepare tracks, and get everything in readiness for the hatchings which could be expected about the middle of December. Mr. Evans, District Commissioner, was detailed to take charge of the work in the Kerio Province.

Relays of officers were appointed, instructed, and sent out to District Commissioners to operate in the infested areas. As more distinct news as to the extent of infestation and its probable intensity was received, further detachments were sent out to reinforce the staff already working. Arrangements were made with the Administration of the Kenya and Uganda Railways and Harbours to operate a train conveying a large quantity of poison, which was sprayed on to the large hopper swarms as they approached the railway line. In addition to effecting much destruction of hoppers delays to trains were rendered less frequent, and where hopper swarms had been sprayed it was again demonstrated that succeeding swarms, coming upon the dead hoppers, succumbed, the first poisoned hoppers acting as poisoned bait.

Thus at the end of the year operations were being energetically conducted by the Administration over an enormous area of country.

The Department had enrolled, trained, equipped and sent out some sixty temporary locust officers. It had twenty-two trucks in the field. Ample supplies were in the field—over 25 tons of arsenic and over 1,000 locust pumps with all necessary water-carrying equipment—buckets, tanks, pumps, and so forth. Further supplies of pumps and arsenic were arriving from South Africa, and did arrive at the end of December.

No operations were necessary in the settled areas, or in Nyanza, as there were no hoppers to contend with, but in every remaining area people were working to a lesser or greater extent. Steps were taken to organise the whole of the settled areas under the system of groups, and everywhere there was manifest that spirit of co-operation which is so essential to the successful prosecution of a campaign against a simultaneous and widespread menace. In December, it became obvious that not half of the infested area could be tackled; the Northern Frontier Province and part of Tanaland could not be reached and handled fully, although detachments were in both areas operating to the best of their ability.

Expenditure on the Second Hopper Campaign, up to the end of the year.

Amount voted: £16,000.

	Shs.
Salaries, travelling, etc.	26,329
Equipment:	
18 fitted motor trucks, 5 motor cycles	82,570
Petrol, upkeep, etc.	32,959
Labour, wages and food	14,769
Arsenite of soda (15 tons)	19,847
Tentage and camp equipment	50,323
Sprays, pumps, hose, tanks, buckets, etc.	41,231
Railage	18,302
Telegrams	215
Sundries	799
	Sh. 287,344

= £14,368 expended.

The hopper campaign did not end until February 28th, 1929, and a full report will be submitted in due course.

E. HARRISON,
Deputy Director of Agriculture.

COLONY AND PROTECTORATE OF KENYA.

THE DISEASES OF PLANTS PREVENTION ORDINANCE.

Rules.

IN EXERCISE of the powers conferred upon him by section 3 of the Diseases of Plants Prevention Ordinance (Chapter 155 of the Revised Edition), His Excellency the Governor in Council has been pleased to make the following Rules :—

1. These Rules may be cited as "the Locust Rules, 1928."

2. In these Rules—

(*a*) "Ordinance" means the Diseases of Plants Ordinance;

(*b*) "Locusts" shall mean the insects *Schistocerca peregrina*;

(*c*) "Hoppers" shall mean immature locusts that are not yet able to fly.

3. Every occupier of land on which locusts deposit their eggs shall immediately give notice of the fact to the nearest Police Officer, and shall state the locality on his land where such eggs have been laid, and such other information as may be required.

4. No occupier of land shall be deemed to be exempt from Rule 3 above by reason of temporary absence from the farm at the time when such eggs were deposited.

5. Wherever any such notice shall have been given as aforesaid to a Police Officer, such Officer shall communicate same immediately to the Director of Agriculture, who may thereupon take whatever action may appear to him advisable.

6. As soon as any hoppers shall appear on any land the occupier thereof shall forthwith—

(i) give notice of the fact to the nearest Police Officer;

(ii) use his utmost endeavours to destroy the said hoppers by the adoption of such measures and the use of such materials as are recommended by the Director of Agriculture.

7. No person shall wilfully drive or attempt to drive or permit hoppers to be driven on to his neighbours' land.

8. In the event of any occupier failing to give the notice required in Rules 3 and 6 (i) above, or failing to destroy the hoppers in the manner prescribed under Rule 6 (ii), the Director of Agriculture or any person authorised by him may carry out the destruction, and the occupier shall be liable for any expenditure thereby incurred.

9. The Director of Agriculture may appoint inspectors under these Rules, and such inspectors shall have the power to enter upon any land where locusts are believed to be or to have been for the purpose of carrying out all or any of these Rules.

10. Any person who without lawful excuse obstructs an inspector in the discharge of his duties under these Rules, or who refuses to permit an inspector to enter upon his land, or refuses to carry out the instructions of an inspector in the discharge of his duties under these Rules, or who otherwise contravenes any of the provisions of these Rules, shall be guilty of an offence, and shall on conviction be liable to a fine not exceeding £100 or in default of payment thereof to imprisonment of either description for a term not exceeding three months.

By Command of His Excellency the Governor in Council.

Nairobi,
This 5th day of June, 1928.

W. M. LOGAN,
Clerk to Executive Council.

APPENDIX T.

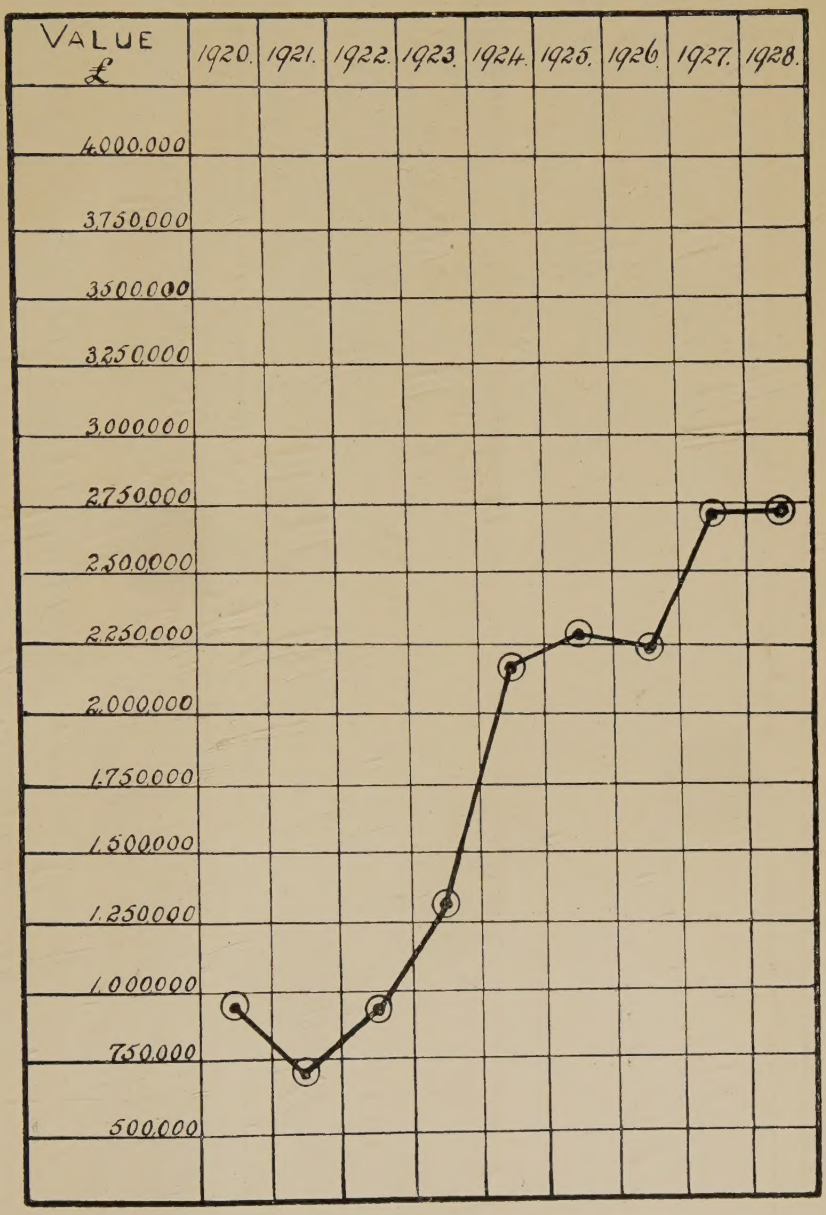



CHART SHOWING GROWTH IN VALUE OF AGRICULTURAL EXPORTS 1920—1928.